MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 37 APRIL, 1931 Number 8

PRINCIPAL ARTICLES IN THIS NUMBER

FOR COMPLETE CLASSIFIED CONTENTS, SEE PAGE 648-D

Cutting Compounds Used by Ford—*By Charles O. Herb* 569
Tungsten Carbide in an Automobile Plant 573
Electrical Tripping Device for Indexing Die—*By E. Martinet and A. Collier* 574
How Many Apprentices Finish Their Course?—*By C. J. Freund* 576
Designing an Unusual Milling Fixture—*By Walter H. Friedrich* 577
Single-dial Indexing Head for High Number of Divisions—*By F. H. Beulwitz* 582
Editorial Comment 586
Standards of Trade Journalism Clearly Defined—Have You Any White Elephants in Your Shop?—Low Production Cost is Not a Sure Sign of Profits
Ingenious Mechanical Movements 587
New Cam Grinding Device of British Design 592
Flexible Shafts and Their Application—*By James M. Talbot* 594
Special Tools and Devices for Railway Shops 599
Design of Static Balancing Machine—*By George L. Pyritz* 602
Pressing Bakelite Disks at High Speed 610
Design of Machine for Bending Copper Pipe—*By Paul H. White* 618
Present-day Nickel-plating Practice 620
The Coordinator in Cooperative Trade Education—*By Traver C. Sutton* 621
Magnetic Methods of Testing Welds 624

DEPARTMENTS

Notes and Comment on Engineering Topics 585
The Shop Executive and His Problems 590
Design of Tools and Fixtures 605
Ideas for the Shop and Drafting-room 612
Questions and Answers 614
New Shop Equipment 629

Total Distribution for March, 17,023 Copies

Product Index 258-278 Advertisers Index 281-282

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS, 140-148 LAFAYETTE STREET, NEW YORK

ROBERT B. LUCHARS, President EDGAR A. BECKER, Vice-pres. and Treasurer ERIK OBERG, Editor FRANKLIN D. JONES, Associate Editor
CHARLES O. HERB, FREEMAN C. DUSTON and JOSEPH E. FENNO, Assistant Editors

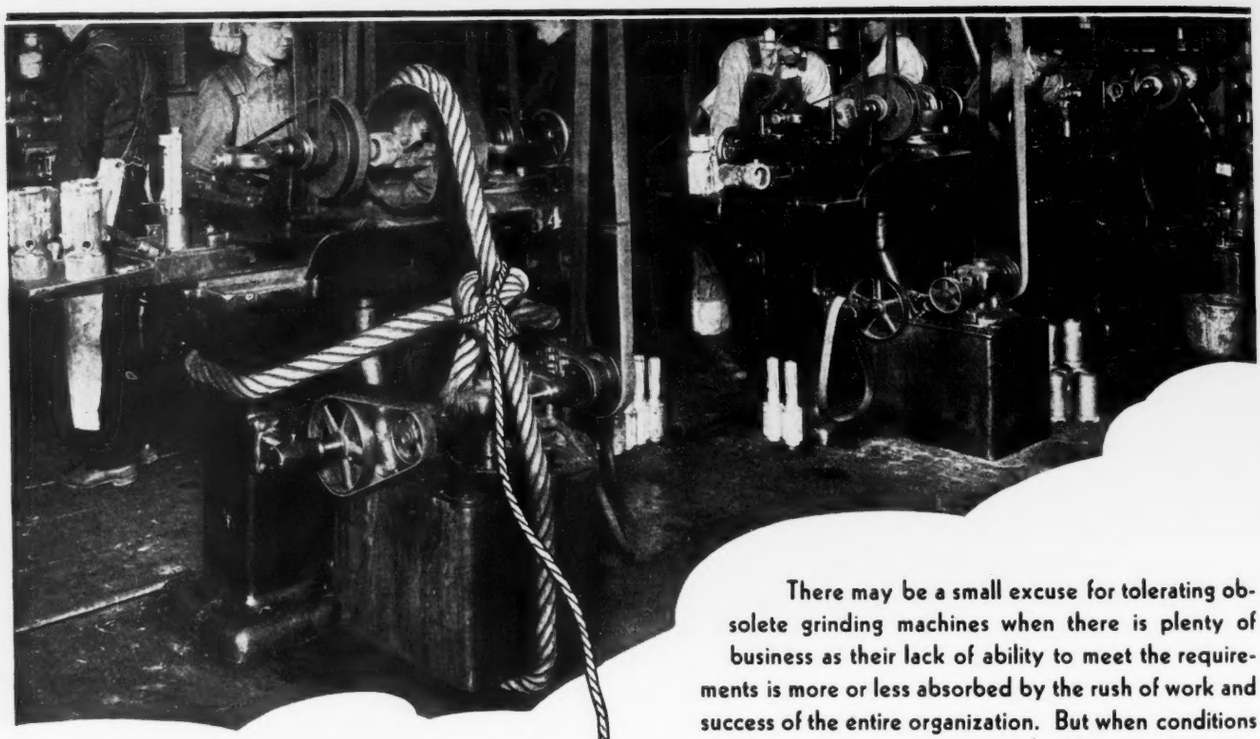
LONDON: 52-54 High Holborn PARIS: 15 Rue Bleue

YEARLY SUBSCRIPTION: United States and Canada, $3 (two years, $5); foreign countries, $6. Single copies, 35 cents.

Changes in address must be received by the fifteenth of the month to be effective for the forthcoming issue. Send old as well as new address.

Copyright 1931 by The Industrial Press. Entered as second-class mail matter, September, 1894, at the Post Office in New York, N. Y., under the Act of March 3, 1879. Printed in the United States of America.

"BLUE TICKET" THE *SLACKERS*



YOUR inefficient employees have long since received their blue tickets. But did you stop there? Did you check your equipment and tie a *blue ticket on the slackers*?

Every machine is an employee whose wages go on in spite of a small amount of work and short hours. If your tools do not rate high when compared with modern equipment, here's where a real saving can be made . . . here's where a replacement means profit — not expense. This is particularly true of grinding equipment on which unusually important improvements have recently been made. These not only increase production but cut the scrap.

The scrap item alone warrants your giving first consideration to the grinding department, for grinding is usually the last operation and scrap means throwing away an expensive part.

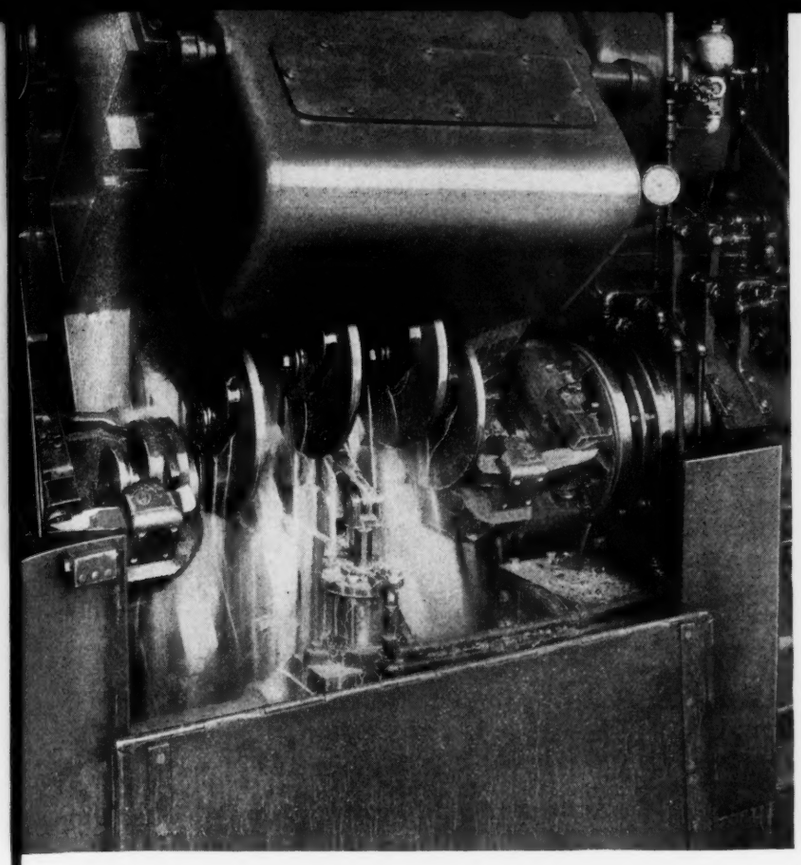
There may be a small excuse for tolerating obsolete grinding machines when there is plenty of business as their lack of ability to meet the requirements is more or less absorbed by the rush of work and success of the entire organization. But when conditions are light — that is when any inefficiency becomes marked and shows up distinctly in the cost.

A phone call to any of our branches or home office will bring an engineer (not a salesman) who will go over your grinding work and furnish unbiased recommendations for better work at less cost.

The Heald Machine Company, Worcester, Massachusetts, U. S. A.

Branch Offices at Chicago, Cleveland, Detroit, New York, Philadelphia and Syracuse

HEALD



MACHINERY

Volume 37 Number 8

NEW YORK

APRIL, 1931

Cutting Compounds Used by Ford

By CHARLES O. HERB

THREE million gallons of cutting compounds are required per month by the American plants of the Ford Motor Co. when they are operating on a normal basis—thirty-six million gallons per year! Small wonder that the subject of cutting compounds should have been thoroughly investigated by chemists and engineers of this company. With such a large amount of capital invested as is represented by this enormous quantity of cutting compound, the management naturally insists on knowing that the shops are using what are believed to be the most efficient compounds for different operations on the various metals.

All cutting compounds used by the Ford Motor Co. are mixed at the Rouge plant, Dearborn, Mich. Compounds intended for other plants of the concern are shipped in barrels from the mixing room, ready to use after water has been added in prescribed proportions. The soluble oil or "soda water" used for ordinary machine work in the Rouge plant is pumped from vats in the mixing room to large pits in the various machine departments. These pits number thirty and have a capacity of 4000 gallons each. From the pits the compound is pumped direct to the machines on which it is used, and then is returned to the pits for recirculation. Other compounds are delivered in containers from the mixing department to the machines. Large common pits are used to supply soluble oil to most of the machines in a department in the other plants of the company also. The compound mixing department in the Rouge plant operates day and night.

This article will give the formulas that have been adopted for different operations, and will explain the means employed in the shop to keep the soluble oil in good condition from a sanitary standpoint.

Qualities Essential in Satisfactory Cutting Compounds

Cutting compounds are used in metal-working operations to assist in removing the metal and speed up the operation; to make the cutting tools last longer; and, in some cases, to obtain a better finish on the work. The functions of a cutting compound are: (1) To cool the work and cutter; (2) to wash away the chips; (3) to lubricate the bearing formed between the chip and the lip of the cutting tool; (4) to enable the cutting tool to pro-

duce a good finish; and (5) to protect the finished product from rust and corrosion.

Of these functions the cooling action is, of course, the most important. During any metal-working operation, the heat generated by friction between the tool and work will raise the temperature of both. If some cooling medium is not employed, the temperature may become high enough to break down the tool. Or, an excessive temperature may cause the work to expand so much during machining that parts finished to size in the machine will be under size after they have cooled, and, consequently, fail to pass inspection. In cutting compounds, water is used as a coolant and oil as a lubricant.

What "Soda Water" Consists of

Three soluble oils known as Nos. 1, 2, and 3 are prepared in the mixing room of the Rouge plant. Of these, the No. 1 is a base oil from which the others are obtained by diluting with water. The formula for the No. 1 or base oil is as follows: Paraffin oil, 27 gallons; oleic acid, 4 gallons; denatured alcohol, 2 gallons; caustic soda solution at 31 degrees Baumé, 1 gallon.

When water is added to this base oil in a 1 to 1 proportion, the No. 2 soluble oil is obtained. This compound is creamy white in appearance and has the consistency of paint. It is used for machining operations somewhat heavier than the ordinary, such as heavy reaming.

Water in the proportion of 24 to 1 is added to the base oil to obtain the No. 3 soluble oil, which has the consistency and appearance of milk. This emulsion is commonly called "soda water" and is employed for all ordinary operations, such as drilling, turning, milling, light reaming, and grinding, unless conditions demand a different compound. It is used on steel, cast iron, and aluminum. Brass is generally machined without a cutting oil, except on certain jobs where the work and tool become excessively hot.

The No. 3 soluble oil is used in large quantities, and is pumped to the pits in the shop. At the pits a disinfectant is added daily in order to keep down the bacteria and avoid infection of machine operators. The bacterial content of the compound in each pit is analyzed weekly, and when the compound becomes polluted to a certain point, it is thrown out and a fresh supply substituted. The precautions taken to insure a sanitary soluble oil will be considered later in this article.

Special Compound for Tapping and Deep Drawing

For tapping operations in almost any metal, white lead is commonly regarded as a good cutting lubricant. The Ford Motor Co. uses a lubricant consisting of a white lead substitute and a heavy oil which are thoroughly mixed to give the advantages of white lead at one-quarter of the cost. The exact formula is as follows: Dry Lithopone (white lead substitute), 400 pounds; talc, 800 pounds; heavy gear oil, 165 gallons; common paraffin oil, 70 gallons; and sulphur, 450 pounds.

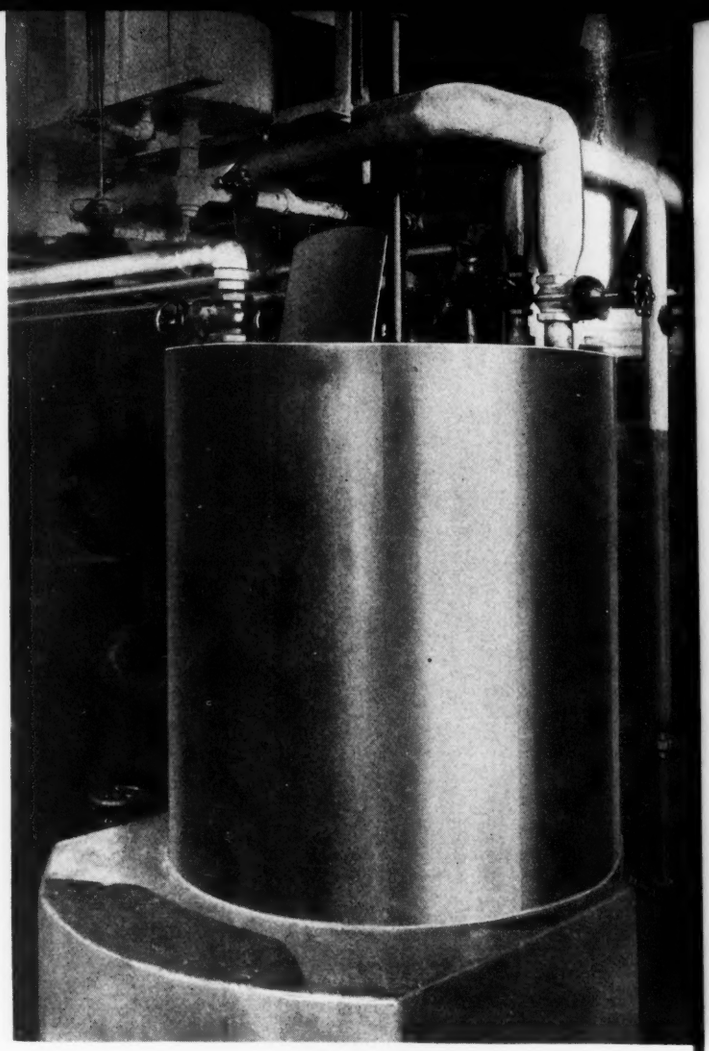


Fig. 1. One of the Mixing Tanks for the Cutting Compounds

This mixture is thick like molasses and is dark in color. In addition to being advantageous for tapping, it has proved particularly satisfactory for deep drawing operations, as it keeps the dies from scoring. Another application is found in lubricating lathe centers.

Cutting Oils for Automatic Screw Machines and Gear-cutting Equipment

Automatic screw machines, Gleason gear generators, Fellows gear shapers, and similar equipment are ordinarily supplied with common paraffin oil. This oil, in addition to facilitating the cut, lubricates the intricate moving parts of the machines; if the No. 3 soluble oil were employed for this purpose, the machine parts might rust when the plant was shut down over week-ends.

However, on certain jobs in automatic screw machines, heavy threading cuts may necessitate the use of a heavier cutting compound in order to avoid torn threads. For such operations, a special oil is supplied which is made up by adding 5 gallons of heavy gear oil and 10 gallons of animal fat to a 55-gallon drum of paraffin oil. This compound is

considered an excellent substitute for the comparatively expensive lard oil usually demanded by production men. Pure lard oil is seldom used in the Ford plants. For cutting pipe threads, the oil just described is supplied.

Compound with Unusually Slippery Qualities Used for Broaching and Common Drawing

For the drawing of fenders, cowls, and other common punch press work, a special oil is used that practically comprises the No. 2 soluble oil with a powder added that gives unusually slippery qualities to the compound. This oil is applied to sheets by means of rolls, and on second-operation work by the use of brushes.

The same compound is also supplied for broaching operations. Its formula is: Paraffin oil, 95 gallons; oleic acid, 18 gallons; denatured alcohol, 9 gallons; caustic soda solution at 31 degrees Baumé, 4 1/2 gallons; Bentonite, 100 pounds; talc, 400 pounds; and water, 200 gallons.

(Bentonite is a colloidal clay also used in foundries for green bond.)

Special White Compound for Drawing Stainless Steel

The compound just described is not suitable for stainless steel; a special white compound is employed in press work on this material. This compound is a solution made by adding one barrel of linseed-oil soap to six barrels of boiling water.

The same compound is also used on some body panel work when the steel is thin and the drawing operations are light. The outstanding value of the compound is that it can be readily cleaned off work with hot water and does not require a special cleaning solution. Incidentally, this cutting compound has been found particularly advantageous in such operations as turning balls and sockets on steel forgings.

Lapping Compound for Running-in Gears

A lapping compound consisting primarily of fine Carborundum and garnet powder suspended in oil is used for running-in gears and similar operations. Cup grease is added to this compound to assist in suspending the grit obtained during the lapping process. The exact formula follows: 3F Carborundum, 270 pounds; 200 mesh garnet, 210 pounds; and 55 gallons of common machine oil to which has been melted and added 45 pounds of cup grease.

How the Cutting Compounds are Mixed

In the "Special Oils and Compounds" department, where all cutting compounds are prepared, there are three mixers of the type shown in Fig. 1. Each of these has a capacity of 400 gallons, and is supplied by means of overhead pipes with the various ingredients in measured quantities, the supplies being kept in tanks on the floor above.

In the mixers there is a horizontal motor-driven paddle wheel which is rotated until the compound has been thoroughly mixed, about twenty minutes being required for mixing seven barrels of the No. 2 soluble oil. From the mixing machines the No. 2 soluble oil is pumped to two overhead tanks having a capacity of 2200 gallons each.

The No. 3 soluble oil is obtained by pumping the No. 2 solution from the two overhead tanks into other tanks of 2000 gallons capacity, where more water is added to give the desired dilution. There are four of these tanks; from them the No. 3 soluble oil is pumped to the pits in the shop. Other compounds are pumped directly from the mixers into barrels, whence they are delivered to the machines. Soluble oil is supplied to the other plants of the Ford Motor Co. in the No. 1 solution, and there mixed with water in the specified proportions to obtain the Nos. 2 and 3 solutions.

Duplex equipment prevents any delay in supplying the No. 3 soluble oil to the shop pits. Automatic signals and controls operate to start pumps for delivering the compound to the pits as it is required and for stopping the pumps when the demand has been met. Fig. 3 illustrates one of the automatic control panels.

The shop pits are of a double design so that one

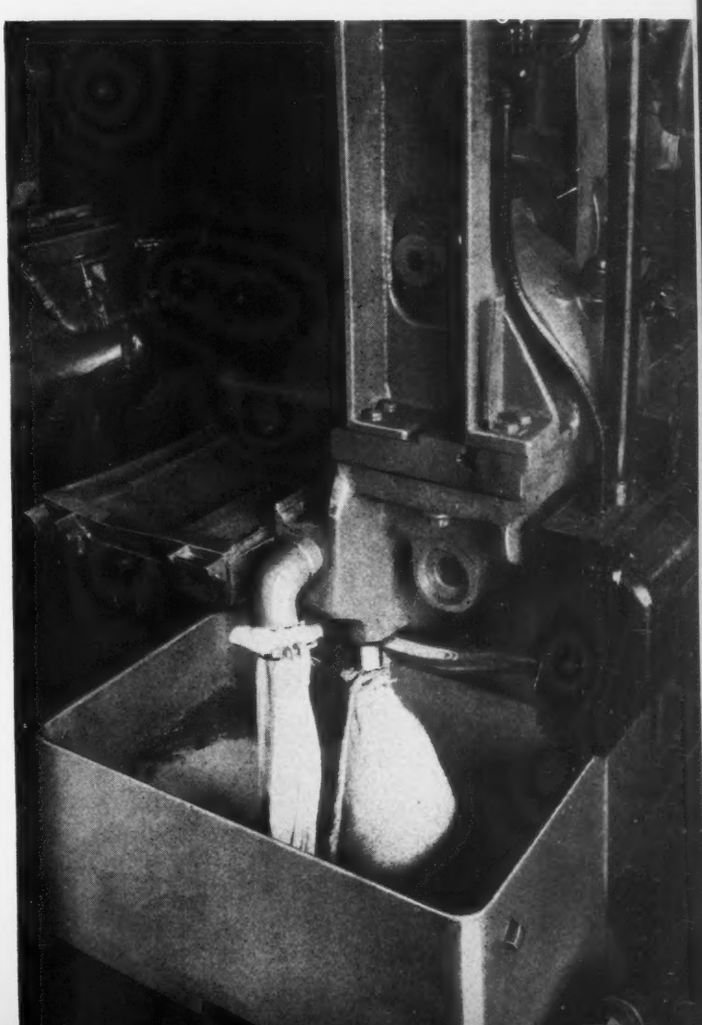


Fig. 2. The Used Compound is Strained through Cloth Bags

side can be cleaned while the other side is in use. Each pit is connected to, perhaps, 1000 machines. The compound is piped overhead to the machines and returns to the pit by gravity after being strained through bags in the manner illustrated in Fig. 2. Steam pipes in the pits heat the cutting compound on winter mornings.

In addition to the convenience of this arrangement of supplying the different machines in a department from one pit, there is the advantage that only one analysis need be made to determine the bacterial content of the compound that is used on each machine.

Disinfectant Protects Employes Against Infection

Extreme care is taken to avoid infection of the men from bacteria in the No. 3 soluble oil, which might develop if impure compound got into slight cuts or scratches. Every morning a phenol disinfectant is added to each shop pit in the proportion of one gallon of disinfectant to 1000 gallons of compound. This disinfectant, as tested by the U. S. Marine Hospital, is fifteen times stronger than a 5 per cent solution of carbolic acid. Disinfectant is also used in the other cutting compounds.

Bacteriological Tests Determine when the Contents of a Shop Pit Must be Discarded

Every Monday or Tuesday morning a chemist takes samples from each pit of No. 3 soluble oil to analyze the bacterial content. A count is made of the number of bacteria colonies per cubic centimeter (0.061 cubic inch). If the count is less than 600,000, the condition of the oil is considered good, because when care is taken in mixing the compound to keep it as sterile as possible, the count approximates 500,000 per cubic centimeter. Hence if the count is less than 600,000, the compound is retained and disinfectant is added.

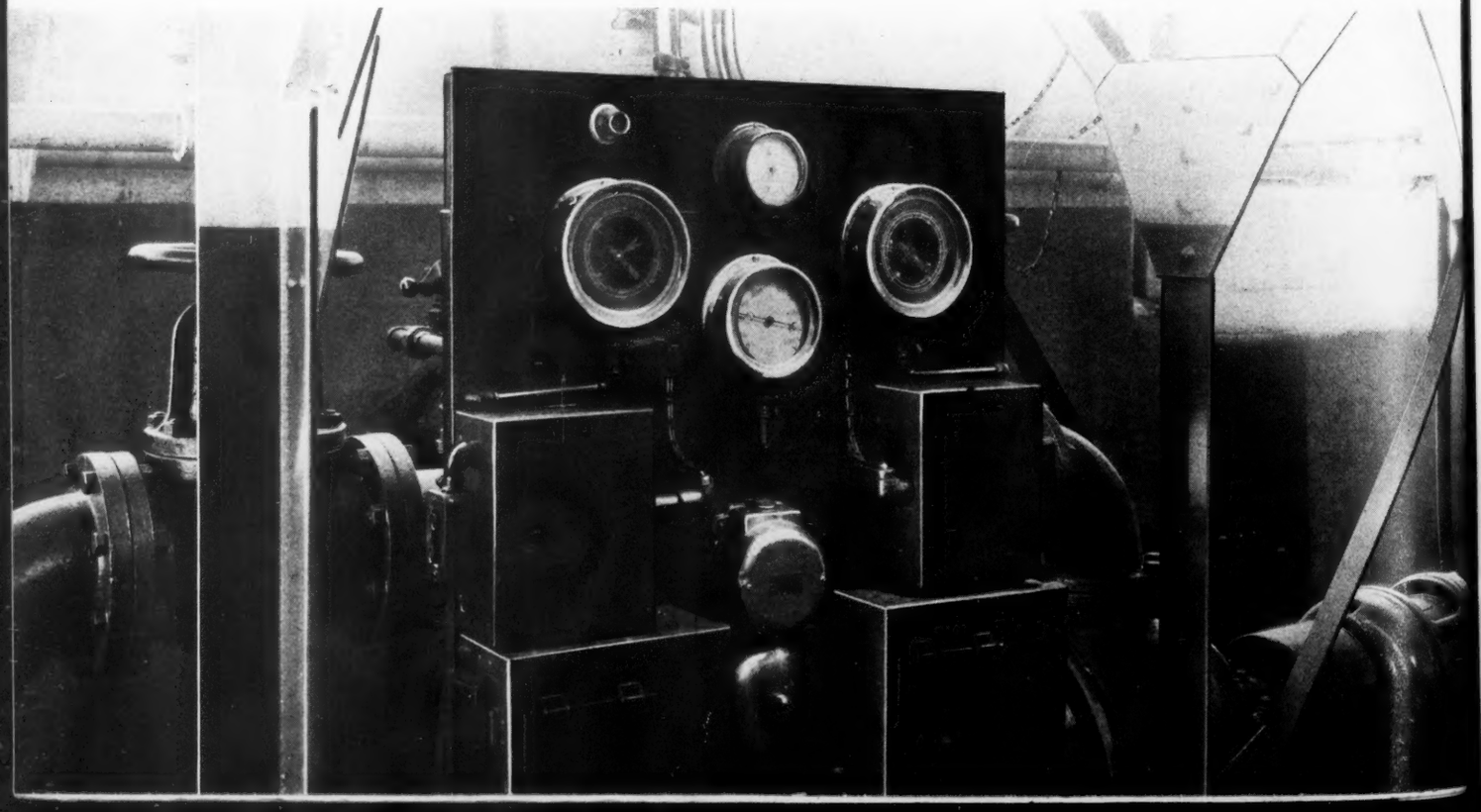
If the count is between 600,000 and 700,000, the condition of the oil is considered fair and it is retained, more disinfectant being added. However, whenever the count is over 700,000, the oil is discarded. With such a high count, the oil will turn rancid, employes will become infected, and work will become rusted.

Every time the contents of a pit are discarded, the company loses $40, but it pays to follow this practice. Since disinfectant has been used in the cutting compound and the bacteriological tests have been inaugurated, the cases of infection have been reduced 80 per cent. Formerly, with fewer employes, four men were required in the infection department of the plant hospital, whereas now there are only two. Obviously, much loss of time due to infections has been eliminated in this way. When it is finally necessary to discard the oil, the pit is scrubbed thoroughly and the walls steamed so as to get rid of all bacteria before the new supply is pumped into the pit.

Some Metals will "Break Down" Soluble Oil

The No. 3 soluble oil must be discarded frequently when used on certain metals that tend to "break down" the solution or, in other words, to separate the oil from the water. Aluminum especially has this tendency, and precautions are therefore taken at the machines to prevent chips from floating in the oil. Cast iron and malleable iron have the same tendency to a lesser degree.

Fig. 3. Automatically Controlled Pumps Supply "Soda Water" to Pits throughout the Plant



Tungsten Carbide in an Automobile Plant

Results Obtained in the Shops of a Leading Automobile Builder where Four Hundred Operations are Being Performed Regularly with Tungsten-Carbide Tools

IN one of the leading automobile plants of the country, thorough experiments have been made to determine exactly where tungsten-carbide tools can be used to best advantage. As a result, four hundred operations are now being performed regularly by the use of these tools, and, in all, one thousand two hundred tungsten-carbide tools are constantly in operation in this shop on production work, in addition to those that are still being used in making experiments.

Briefly, the greatest success has been obtained by using these tools on operations that do not require an intermittent cut. Hence, they are largely used in turning and boring machines. They have not yet been applied to any considerable extent on steel, but it is probable that the tungsten-carbide materials now being brought out will prove successful for cutting steel as well.

Materials on which the New Tools have been Most Successfully Employed

The materials on which tungsten-carbide tools have been must successfully used are hard bronze, malleable iron, cast iron, and aluminum alloys. Among the parts being turned, faced, and bored with these tools are flywheels and clutch plates. So far, milling cutters with inserted teeth tipped with tungsten carbide have not been used to any great extent for milling cast iron, but experiments are now being conducted with these tools, and it is likely that cast-iron cylinder blocks may shortly be milled by cutters of this kind. On the other hand, such milling cutters have proved extremely useful in milling aluminum alloys.

In one instance, crankcases are being milled. Before the application of tungsten-carbide cutters, only about 70 cases could be completed between grindings. A 26-inch tungsten-carbide tipped cutter is now used; this cutter has milled about 13,000 cases without regrinding. When the cutter needs sharpening, it will require the removal of only about 0.010 inch per grind, and it is estimated that it will last for about 500,000 crankcases.

Counterboring with Tungsten-carbide Tools

Tungsten-carbide tools are also used for a difficult counterboring operation on the crankcase. The tools formerly used lasted only for from 8 to 14 cases, while the tungsten-carbide tools complete about 1700 cases. Incidentally, the latter tools can be used without a coolant, which is a considerable advantage in many ways.

The rough-boring of crankshaft and camshaft holes is now being done with tungsten-carbide tools instead of with a diamond, as heretofore. However, the edge will not retain its smoothness and sharpness as well as a diamond, and for smooth finish-boring the diamond is still considered the best means.

The complete tool equipment for turning and boring valve stem bushings is now made from tungsten carbide. Almost entire freedom from tool troubles has been achieved, and one man is now able to run two machines, the machines being in constant use, as frequent tool setting or tool grinding has been eliminated.

Unusual Applications of Tungsten Carbide

Some unusual applications of tungsten carbide may prove of interest. In one instance, it has been found advisable—now that it is feasible—to drill certain automobile parts after they have been hardened. This is now done successfully with tungsten-carbide tipped drills, an operation that it was impossible to perform in the past.

Another interesting application is the use of tungsten carbide for a work-rest on a centerless grinder. In the past, these work-rests would last for only about 1000 pieces. By using a small piece of tungsten carbide at the point of greatest wear on the work-rest, 40,000 pieces have been put through the machine up to the present time without the tungsten carbide showing any appreciable wear.

Experiments have been made in the use of tungsten carbide for dressing grinding wheels, with partial success. This is a development that will probably meet with greater success in the future.

The Best Method of Brazing the Tool to its Supporting Shank

Experience in the automobile plant referred to indicates that the best brazing material for fastening tungsten carbide to its steel support is thin copper. Before brazing, it is necessary to clean both the steel support and the tungsten-carbide tip thoroughly. The contact surfaces must not even be touched by the hands or allowed in any way to become greasy or oily. Pure copper about 1/64 inch in thickness is used between the tool and the support. The two parts are held together by wires and placed in a furnace, after which they are pressed together securely.

* * *

When it is necessary to balance a wheel or rotor statically and there are no regular balancing ways available, a very satisfactory substitute may be made by laying two pieces of small shafting or drill rod across two pairs of V-blocks elevated to the required height by parallel blocks. The rods should be straight and they should be carefully leveled in both directions.

Electrical Tripping Device for Indexing Die

By E. MARTINET and A. COLLIER
The P. A. Geier Co., Cleveland, Ohio

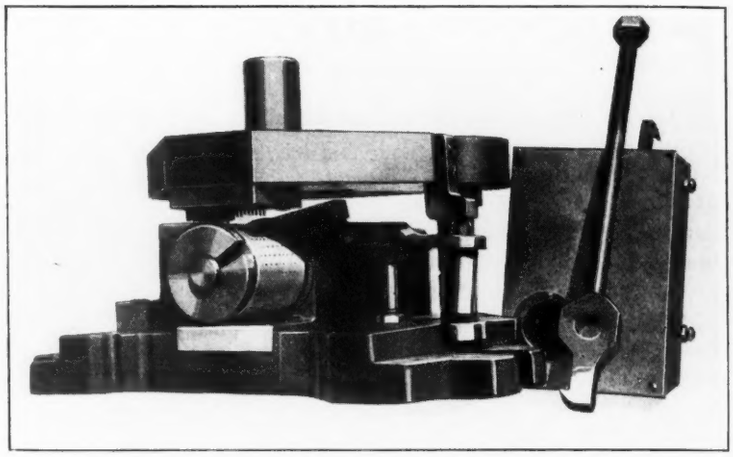


Fig. 1. Indexing Die Equipped with Electrical Device for Tripping Press after One Revolution of the Work

AN indexing die having an electrically controlled device for tripping the press automatically after the work has been indexed one complete revolution is shown in Fig. 1. The die was designed to pierce a series of 1/16-inch holes around an aluminum cup 2 1/4 inches in diameter and 2 1/4 inches long. The thickness of the stock used for these cups is 0.025 inch. Thirty-two equally spaced rows of holes, with nine holes to a row, are pierced in each cup, making a total of 288 holes.

From the sectional view, Fig. 2, the construction of the die will be readily understood. The part to be pierced is placed on the plug *A*, and clamped by turning the U-washer *B* a quarter of a revolution. Plug *A*, into which a hardened tool-steel die section *C* is inserted, is stationary and is fastened to the angle-plate *D*. The slugs pierced from the cup drop through the holes shown in the sectional view. The sides and the bottom of the plug are cut away to allow the work to revolve freely on it. The work is indexed and rotated by means of the center shaft *E*, which, in turn, is rotated by the ratchet wheel *F*.

At the end of shaft *E* is a flange *Y*, in which three equally spaced pins are secured. These pins locate the work correctly and also serve as drivers for revolving the cup. On the indexing arm *G* is pivoted the pawl *H* which operates the ratchet wheel *F*, and to the top of this arm a rectangular-shaped piece *J* is fastened by means of flat-head screws. This block engages another ratchet wheel *K*, the teeth of which are of the opposite hand to those of wheel *F*, and locks both wheels after the indexing movement is completed.

Underneath arm *G* will be seen the mechanism *L*, which also locks the ratchet wheels. This second locking action is necessary to prevent the operator, when loading and unloading, from getting the electrical tripping device out of synchronism with the indexing mechanism when arm *G* is not engaged with ratchet wheel *F*. Although there are thirty-two rows of holes to be pierced, each of the ratchet wheels has but sixteen teeth, two rows of punches being mounted in the punch-block (see Fig. 1).

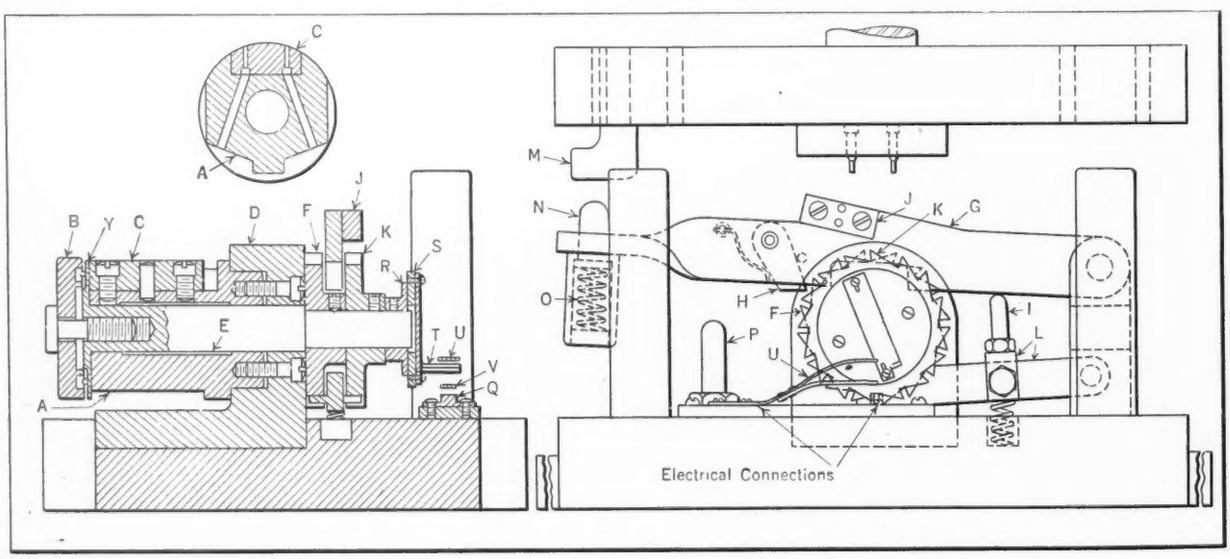


Fig. 2. Construction of Die Illustrated in Fig. 1, Showing the Ratchet Mechanism for Indexing the Work

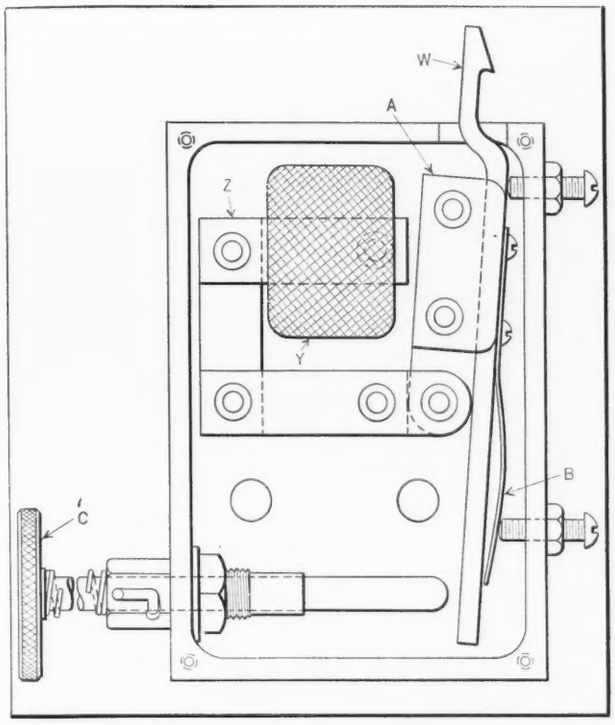


Fig. 3. Electrical Device for Tripping Press when the Work in the Die Shown in Fig. 1 Makes One Revolution

These punches are so spaced that each hole is pierced only once during the entire indexing.

Operation of Indexing Die

As the press ram descends, the heel *M* fastened to the punch-holder comes in contact with the pin *N*, which is backed up by a spring *O*, strong enough to move the indexing arm without being compressed. When the indexing movement has been completed, arm *G* comes in contact with the stop *P*, after which spring *O* is deflected the distance required to complete the stroke of the ram. Besides serving as a stop, pin *P* acts as a support for the index-bar while the cup is being pierced.

From the construction shown, it will be apparent that when the index-bar is moved downward, the locking mechanism *L* is released. Pawl *H* then turns the ratchet wheels and the piece *J* drops in place in the ratchet teeth, thus completing the indexing movement. At the end of the up stroke, index-arm *G*, being in the up position, allows the mechanism *L* to return to the position indicated, locking both ratchet wheels against rotation in either direction.

At one end of shaft *E* is an adjustable arm *T*, mounted on a Bakelite disk *S* which, in turn, is fastened to a steel disk *R*. At the end of every revolution of the cup, the spring *U* is depressed by arm *T*, making an electrical contact between the members *Q* and *V*, which disengages the arm *W* (Figs. 3 and 4) in the trip mechanism. The tripping device is mounted on the press as shown in Fig. 4. Here, the arm *X* replaces the standard arm on the punch press. The magnetic circuit of the tripping device is made up from laminations 0.018 inch thick, stacked to a cross-section of 3/4 by 1 inch, producing a pull on the movable arm *W* of approximately 15 pounds. The coil is made up of 650 turns of No. 24 cotton-covered wire.

Operation of Tripping Device

Referring to Fig. 3, member *W* is the tripping arm, *Y* the coil, and *Z* the laminated core. The movable part of the core to which arm *W* is fastened is shown at *A* while at *B* is shown a leaf spring, which forces arm *W* back after the circuit has been broken.

It will be apparent from Fig. 4 that when the operator depresses the foot-pedal, arm *X* will engage the latch on arm *W* and hold the foot-pedal down until the adjustable arm *T*, Fig. 2, closes the circuit. This energizes the coil in the tripping device and causes arm *X* to be released. This device is operated on a 110-volt alternating-current line.

The plunger *C*, Fig. 3, when pushed in and held in position by means of the bayonet lock, forces arm *W* away from arm *X*, Fig. 4, thus allowing other jobs to be done without disturbing the tripping device, which is permanently fastened to the press. When the tripping device is being used, plunger *C*, Fig. 3, is released, leaving arm *W* free to operate.

Another advantage of this device is that the press can be tripped at any time while the electric trip is in operation by merely pressing plunger *C*. It is believed that this tripping device could be used to advantage on many jobs of a similar nature. The die, complete with tripping mechanism, was made at a cost of about $200.

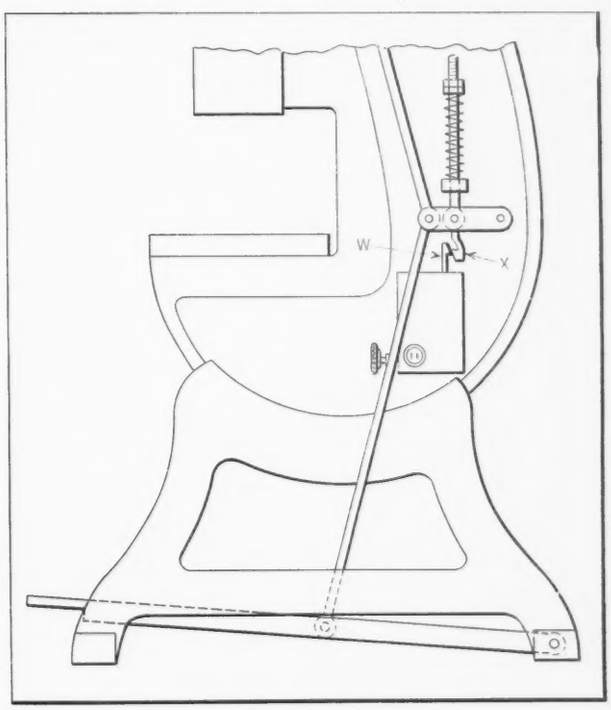


Fig. 4. Manner in which Tripping Device is Attached to the Press

How Many Apprentices Finish Their Course?

The Records of a Company Having a Highly Developed Apprenticeship System Show a Higher Percentage for Apprentices than for High School and College Students

By C. J. FREUND, Apprentice Supervisor
The Falk Corporation, Milwaukee, Wis.

FEW manufacturers give serious thought to the broad general problems confronting their industry. Their attention is mainly centered on the immediate difficulties and problems that arise in their own business. The lack of interest in general problems is especially noticeable as regards apprentice training.

You may tell a manufacturer that 5 per cent of American mechanics are lost to industry every year and that for every five men lost, only one or two trained young men enter the industry; you may tell him that most of the skilled mechanics in the country are over middle age and that when they step out of their trade, there will be none to replace them; you may tell him that American manufacturers, while giving much attention to finance, accounting, and production, give too little thought to the training of men and other questions affecting their personnel; you may finally tell him that he should bear his share of the burden of training young mechanics; and his answer will probably be:

"That's all very fine, but I cannot bother with apprentice training in this plant. It would not be practical. I know of a plant right here in town where they train apprentices, and most of them quit when they are half through the course and try to get jobs as full-fledged machinists. Have you any honest-to-goodness figures to show me what proportion of apprentices finish their course?"

This is a practical question and one that deserves a straight answer. It is frequently asked by those who are merely curious about apprentice training, by those who are contemplating the matter seriously, and by those who have been training apprentices for a long time, because they believe in the system, although they have no actual information as to the results obtained.

The records that have been kept in the apprentice department of the Falk Corporation answer this question. From January 1, 1924, to February 28, 1929, the number of apprentices taken into the plant was 262, none of whom are apprentices at the present time. Those who are still apprentices with the company were not included in this count, because it is impossible to say whether or not they will finish their course.

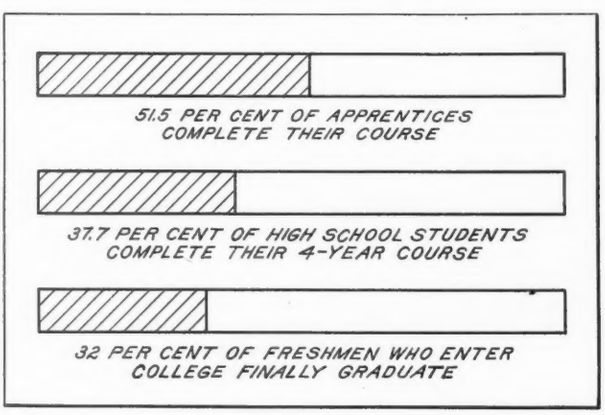
Of the 262 apprentices mentioned, 135, or 51.5 per cent, have graduated. Since the admission to the apprenticeship course, or the "indenture," does not take place until the probationary period of three months has passed, the probationers who left before entering on their apprenticeship course were not included.

At first sight, a training program under which not more than half the apprentices graduate may appear ineffective. However, let us compare this result with the records of graduates from our high schools and colleges. The comparison is a fair one, because apprentice training is an educational activity. Most people feel that the American educational system is effective, in spite of its deficiencies. According to the United States Bureau of Education, for approximately the same years as those covered by the Falk Corporation's apprentice records, 32 per cent of the freshmen enrolled in the colleges and universities of the country graduated, and 37.7 per cent of first-year high school students completed the fourth year of their course. By comparison, 51.5 per cent of apprentice graduations is quite a favorable showing.

Moreover, the time devoted to the training of the apprentices who do not graduate is not wasted. Efforts made to teach young men are never wasted. Most of the boys who do not graduate remain in the industry, and the period of training, however short, enables them to do better work than they would have been able to do as unskilled laborers; in addition, their value to the industry is increased.

The figures here given are from one plant only; different conditions and circumstances may produce different results. In the Falk Corporation, however, the proportion of graduates is increasing. During 1929, only two indentured apprentices gave up their training. In 1930, this number was three.

It may be worth while to point out that the expression "apprentice," as used in this article, applies only to young men who are given a definite program of training according to the provisions of a written contract.


51.5 PER CENT OF APPRENTICES COMPLETE THEIR COURSE
37.7 PER CENT OF HIGH SCHOOL STUDENTS COMPLETE THEIR 4-YEAR COURSE
32 PER CENT OF FRESHMEN WHO ENTER COLLEGE FINALLY GRADUATE

Proportion of Apprentices who Complete Their Course, as Compared with Young Men Who Complete High School and College Courses, Based upon Records of the U. S. Bureau of Education and of the Falk Corporation

Designing an Unusual Milling Fixture

Fixture for Milling Teeth in Knitting Machine Parts and a Device for Breaking out Teeth to Suit Knitting Specifications

By WALTER H. FRIEDRICH

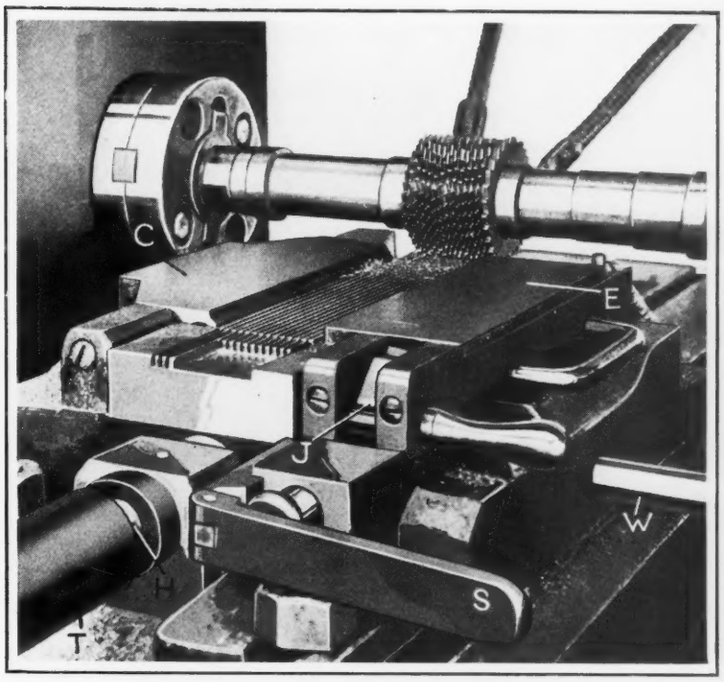


Fig. 1. Fixture and Gang Cutters Used in Milling Slots in Knitting Machine Part Illustrated in Fig. 3

THE part shown in Fig. 3 is known as a "trick," and will be recognized by those familiar with a certain type of knitting machine as one of two styles commonly used in the so-called "design cylinder." The style shown has thirteen teeth, while the other style—not shown—has eighteen teeth, cut in a much shorter space, the width of the slots being held within limits of 0.019 and 0.021 inch, while the combined width of one tooth and the adjacent slot is held within limits of 0.067 and 0.068 inch.

The two styles of tricks are alike, except for the teeth, and are blanked out from spring steel by the same die. Both tricks must be held within the tolerances shown in Fig. 3. As these pieces are required in large quantities, machining equipment capable of high production as well as a fine degree of accuracy is necessary. The methods described are employed by the H. Brinton Co.

The fixture employed for milling the slots that form the teeth of the part is shown in Fig. 1. This is of the straight-line, continuous-milling type, and consists primarily of a base, secured to the milling machine table, and two interchangeable units, shown at *A* and *B*, Fig. 2. Each unit holds 100 tricks, and while the unit *A* is in use on the machine the unit *B* is reloaded by the operator. Details of the two work-holding units are shown in Fig. 4. The construction of the fixture proper is shown by the plan, side, and end views in Fig. 5. The time required to mill the tooth slots in 100 tricks of the style shown in Fig. 3 is 2 1/2 minutes.

The time required to remove one of the units, insert the other, clamp, and place the fixture in the cutting position is 0.70 minute. This

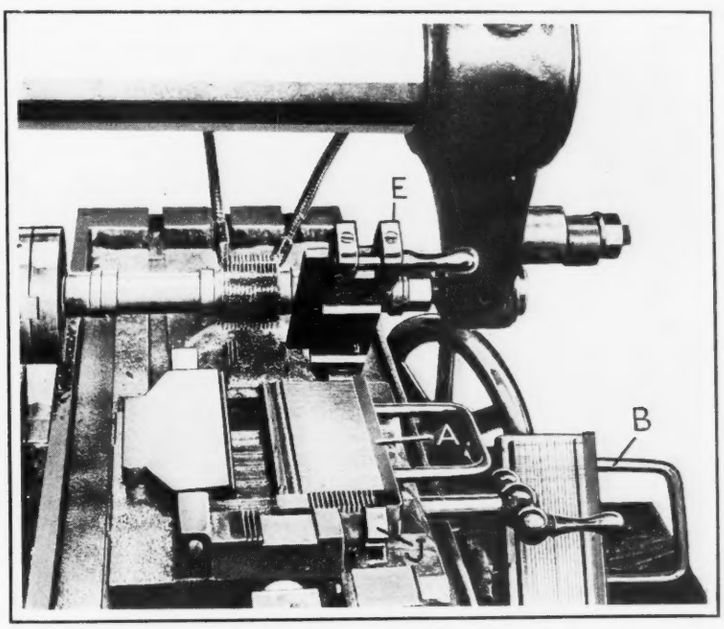


Fig. 2. Fixture Shown in Fig. 1 with Leaf E Raised to Permit Changing Work-holding Units A and B

WALTER H. FRIEDRICH was born in Philadelphia in 1901. After having completed his high school course, he obtained his technical education by studying for six years in the Philadelphia evening schools, including four years at the Drexel Institute, where he took a course in machine design. During this time he was employed by several companies in Philadelphia, including the Western Electric Co. and the J. F. Johnson Co., as tool draftsman. In 1920, he started to work as a tool designer with the Brown Instrument Co., serving later in the capacity of assistant tool-room foreman. Since 1924 he has been employed by the H. Brinton Co., in Philadelphia, with whom he now holds the position of chief tool designer.

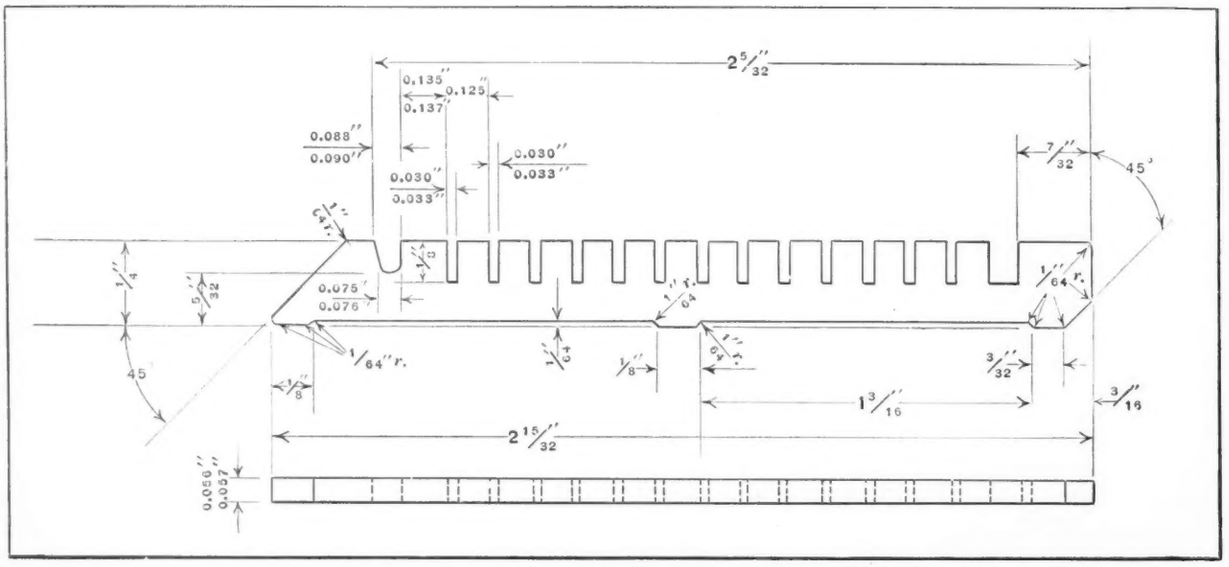


Fig. 3. Knitting Machine Part Known as a "Trick"

makes a total of 3.2 minutes per cycle of operations, or a total of 3.2 minutes to complete the milling of 100 tricks. It has been found that 2 1/2 minutes is an ample allowance for loading a unit, and the operator has therefore been placed on a piece-work basis.

Speeds and Feeds for Milling Slots

The best cutting speed, using the gang cutters shown in Fig. 1, was found to be 204 revolutions per minute, at a feed of 2 1/2 inches per minute. A stream of lubricant is directed on the cutters during the milling operation. With the feed and speed used, there is a minimum amount of saw breakage. The saws are reground after completing each lot of 5000 pieces. The hardened steel collars between the saws come within 3/16 inch of the cutting ends of the teeth. As the slots are cut to a depth of 1/8 inch, there is a clearance of 1/16 inch between the work and the collars. The saw arbor is equipped with hardened and ground keys. In milling the slots in the style of trick having eighteen teeth, it was found necessary to reduce the feed to 1 inch per minute, owing to the larger number of saws required and the thinner saws used.

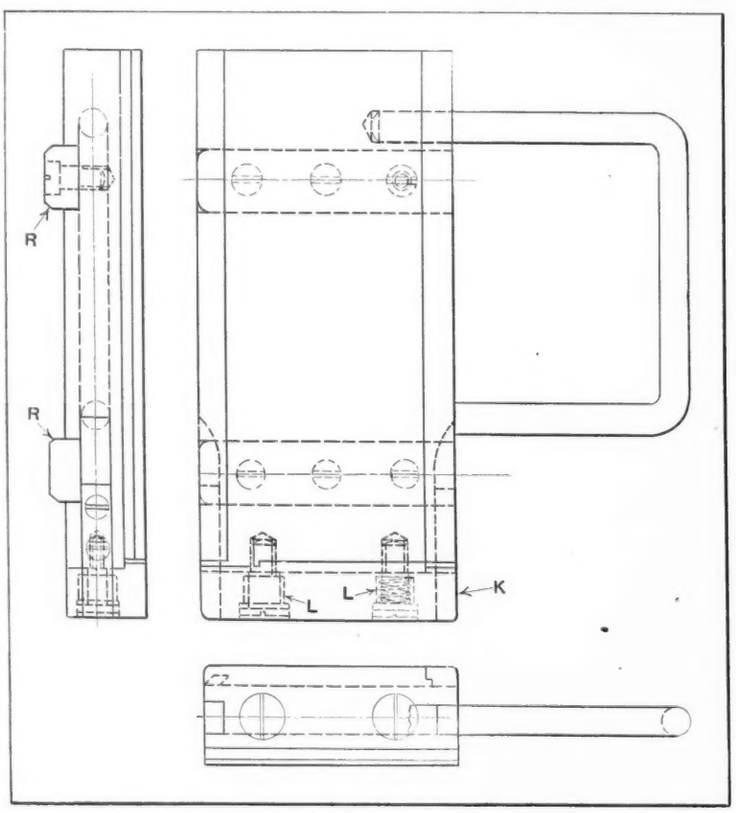


Fig. 4. Details of Work-holding Unit of Fixture Illustrated in Figs. 1 and 2

Referring to Fig. 3, it will be noticed that the slots are dimensioned from the V-notch, which made it necessary to locate the pieces from this notch for the milling operation. The locating device shown at *C*, Fig. 5, meets all requirements in this respect and also serves as a clamp, preventing the work from rising in the holder.

The handle *D* for actuating the clamp *C* is located at the front of the fixture, in a convenient position to be grasped by the operator. At the opposite side of the fixture the work is held in position by the pivoted clamping arm *E* shown in Figs. 2 and 5. This arm can be swung upward, and is held in the position shown in Fig. 2 by the spring *F*, Fig. 5. When the arm is in this position, the work-holding unit can be easily withdrawn or replaced.

After the slots have been cut in the pieces held in one of the units and the table returned to the position shown in Fig. 1, the clamp *C*, Figs. 1 and 5, is released by turning crank *D* on shaft *W*.

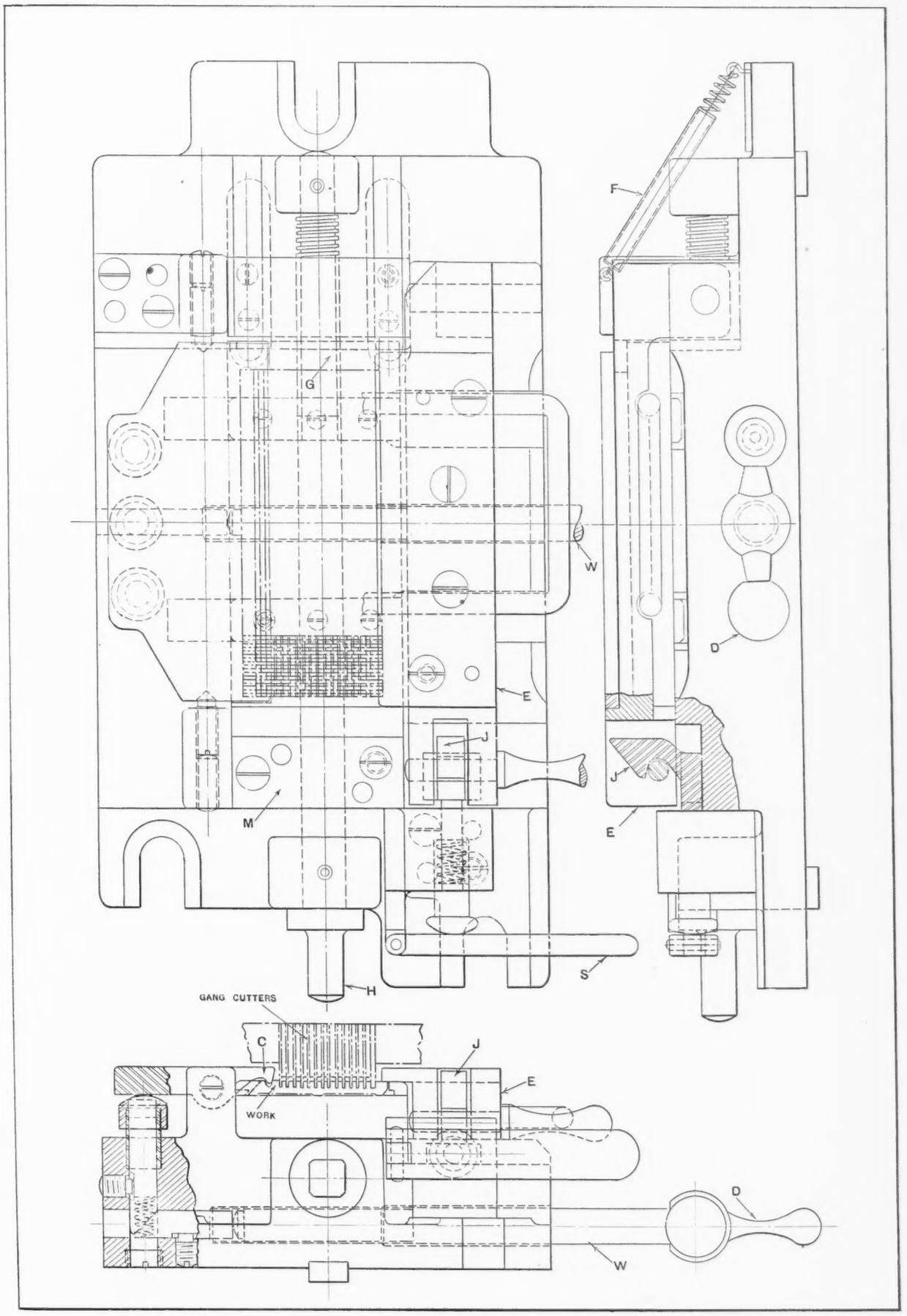


Fig. 5. Assembly Views of Milling Fixture Shown in Figs. 1 and 2, with Work-holding Unit in Place

The arm *E* is then unlocked by means of lever *S* and raised, as shown in Fig. 2. The jaw *G*, Fig. 5, is next opened by turning screw *H*. The unit *B*, Fig. 2, with the pieces just milled can then be removed and replaced by the unit *A*, newly loaded.

After sliding unit *A* into position, the locating clamp *C*, Fig. 5, is tightened lightly. The clamping arm *E* is then dropped and locked in position automatically by latch *J*. (The design for this latch is described in MACHINERY'S book, "Jig and Fixture Design," page 126.) The vise jaw *G* is next closed and the locating clamp handle *D* given a final tightening movement. The fixture is then fed forward so that the gang cutters enter the work. The handle *T*, Fig. 1, used to turn screw *H* extends over the end of the milling machine table.

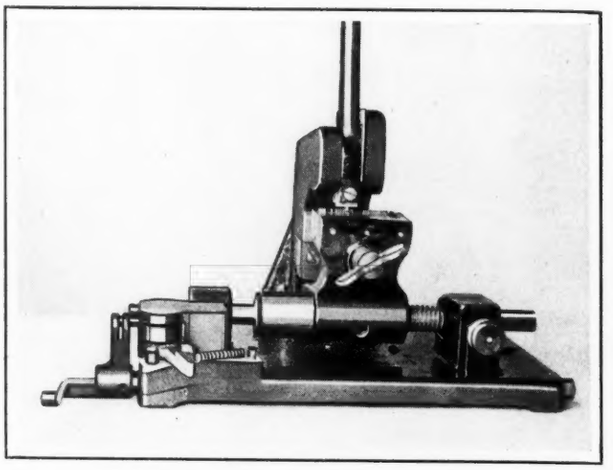


Fig. 7. Device for Breaking out Teeth of Knitting Machine Tricks to Suit the Design

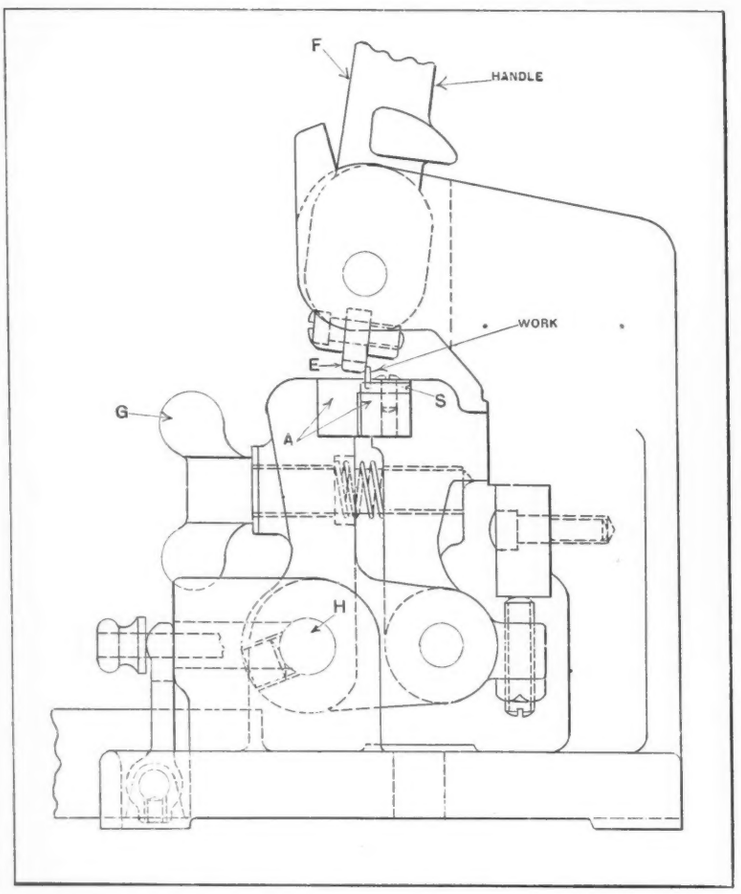


Fig. 6. End View of Device Shown in Fig. 9

After milling the slots, the tricks are hardened, spring tempered, and finished by tumbling. Before they can be used in the knitting machine, it is necessary to knock or break out the teeth that are not needed. Every conceivable combination of tooth spacing is used, ranging from a trick containing all the teeth to one in which all the teeth have been removed. The arrangement of tooth spacing is governed entirely by the requirements of the design knitted in the fabric.

When the tricks are inserted in the longitudinal slots in the periphery of the design cylinder, the spaces or paths formed by the broken out teeth remind one of the grooves of a barrel type cam. As large quantities of tricks must be prepared for use in the cylinders, the special device shown in Fig. 7 was designed for breaking out the teeth.

In operating this device, the trick is placed between the hardened clamping jaws *A*, Fig. 9, and against the end stop *S*. The jaws are then tightened by means of the wing-nut *G*. A simple movement of the handle *F* will break out one of the teeth when the work is clamped.

The units *A* and *B* which hold the work are equipped with hardened and ground keys *R*, Fig. 4, which engage slots in the fixture base. This construction insures accurate alignment of the work in the fixture. Attached to one end of the unit is an auxiliary jaw *K* which has a longitudinal movement. This jaw is held against the unit by the tension of springs *L*. When the unit is inserted in the fixture, there is a clearance of 1/32 inch between the auxiliary jaw and the block *M*, Fig. 5. This facilitates loading and unloading. The solid support *M* takes the thrust.

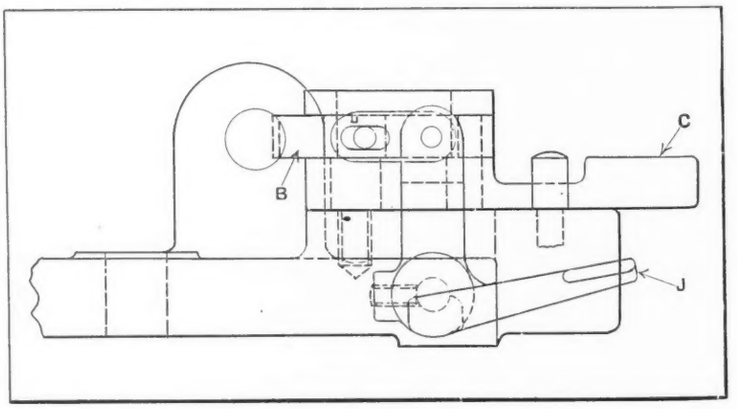


Fig. 8. End View of Members J, B, and C, Fig. 9

The locating of the work for breaking out the teeth is done by indexing. The indexing teeth in rack *H* have the same spacing as the teeth in the work. Two interchangeable racks *H* are provided with each device for the two styles of tricks.

The indexing mechanism *B*, operated by lever *C*, moves the jaws holding the work the desired number of spaces, one movement of lever *C* serving to move the trick forward one tooth space. The pawl *D* locks the rack in position as *B* drops back. When the tooth to be broken out is brought in front of the hardened knock-out blade *E*, Figs. 6 and 9, it is snapped off by a movement of lever *F*.

By pressing down on the lever *J*, the pawls *B* and *D* are disengaged, and the work-holding jaws are returned automatically to the starting position. The manner in which lever *J* and pawl *B* operate will be understood from the end view, Fig. 8.

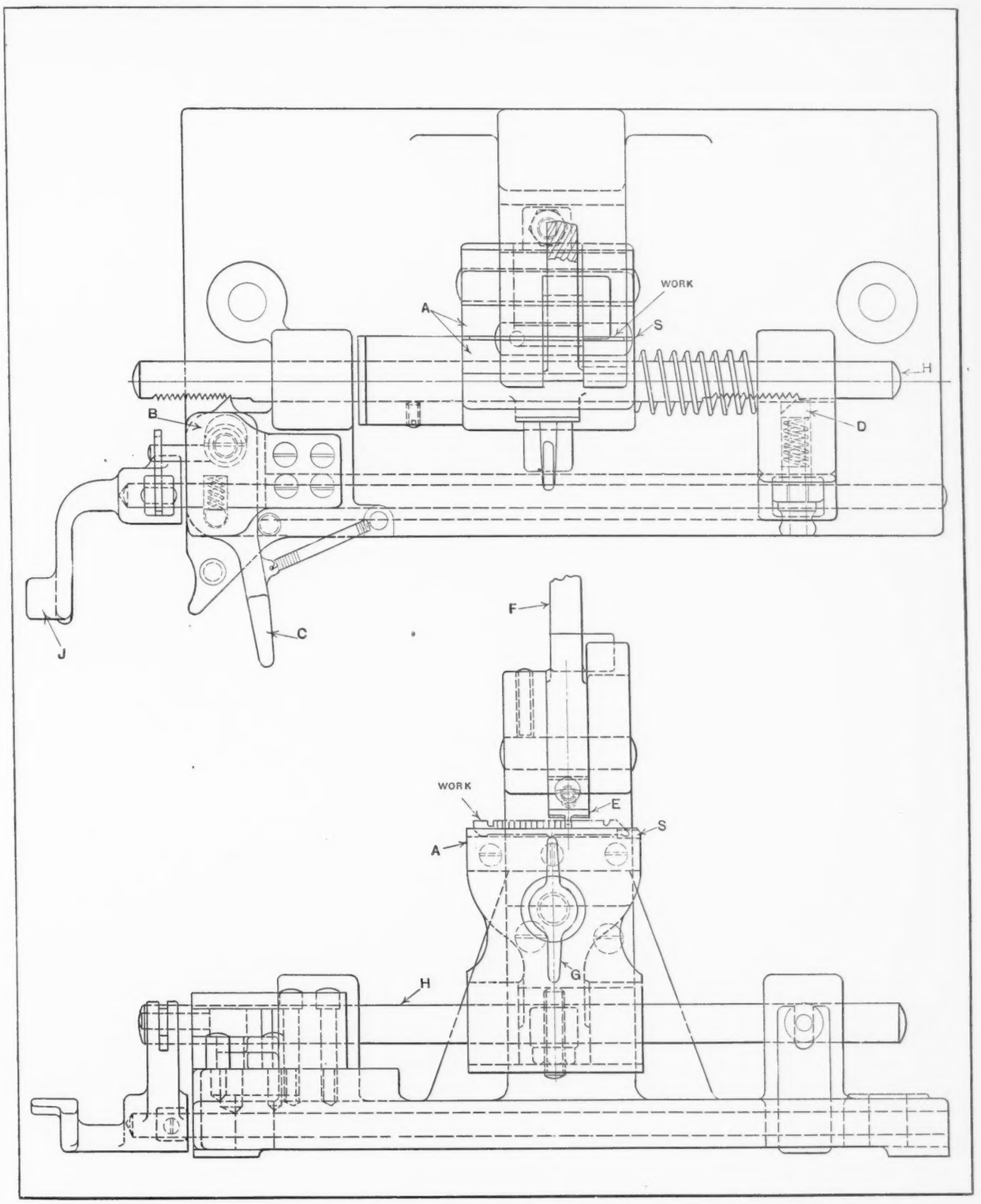


Fig. 9. Assembly Views of Device Shown in Fig. 7 for Breaking out Teeth of Knitting Machine Tricks

Single-dial Indexing Head for High Number of Divisions

A Ratio of 4000 to 1 Permits a Wide Range of Divisions to be Indexed Accurately Enough for Ordinary Requirements

By F. H. BEULWITZ, Western Electric Co., Chicago, Ill.

PRACTICALLY any division required for ordinary work may be indexed with a degree of accuracy sufficient for most jobs by means of the dividing head shown in Fig. 1. This eliminates the use of interchangeable dials and gears, as all the divisions are readily obtained by means of a single dial containing only one circle of holes. Because of its extensive range and its single dial feature, this head is ideal for work requiring the indexing of unequal divisions or those designated by angles. Moreover, the calculations involved in determining the number of turns of the indexing plunger is so simple that a tabulated chart is unnecessary.

The indexing movement is transmitted to the work in the ratio of 4000 to 1 by means of epicyclic gears and a worm and worm-gear. Provision is made for rapidly locking the epicyclic gear in order to reduce the number of full turns of the indexing plunger. This arrangement results in a great saving of time, inasmuch as 4000 turns of the plunger are required to rotate the work-spindle once while the gears are unlocked.

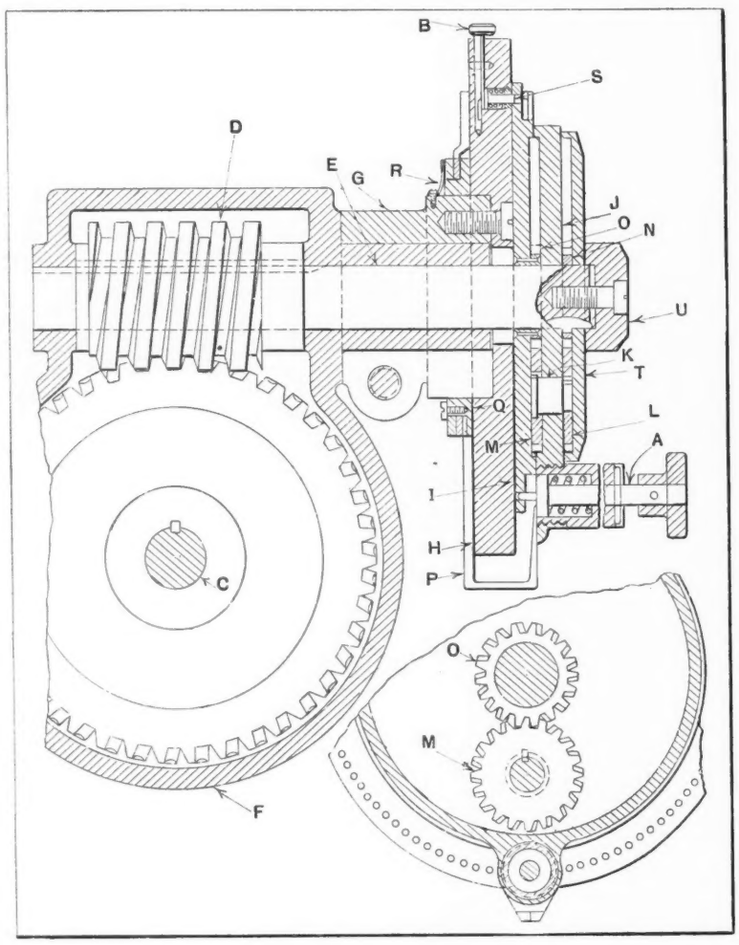


Fig. 1. Single-dial Indexing Head Mechanism, Showing Differential Gearing and Locking Arrangement

The head is operated by the indexing plunger *A* and the locking plunger *B* shown in Fig. 1. These plungers are also shown in Fig. 2, the same reference letters being used in both illustrations. On the work-spindle *C*, Fig. 1, is keyed a worm-gear having forty teeth. Meshing with this gear is the worm *D*, which is secured to the shaft *E*. Shaft *E* rotates in bearings that are integral with the upper part of the stationary body *F*.

On the outside of the right-hand bearing is clamped the split sleeve *G* carrying the locking disk *H* in which is assembled the locking plunger *B*. This arrangement provides for making slight adjustments of the work relative to the milling cutter, by loosening the clamping screw and rotating the sleeve the required amount on the bearing.

Adjacent to the locking disk is the indexing dial *I*, which is free to turn on the shaft *E*. Around this dial, near its edge, are located one hundred holes, equally spaced, with which the plunger *A* and the pin *S* may engage. The plate *J* is also free to turn on shaft *E* and contains a hole in which the short shaft *K* rotates. To shaft *K* are keyed the two small gears *L* and *M* meshing with the gears *N* and *O*. Gear *N* is fastened to the indexing dial *I* and turns freely on shaft *E*. Gear *O*, however, is keyed to this shaft. Plate *J* also serves as a carrier for the indexing plunger *A*.

The gears *L*, *M*, *N*, and *O* are designed so that they will operate as an epicyclic train, the gears on shaft *K* rotating about those on shaft *E*. The gear ratio is such that one revolution of the indexing dial *I* will cause the shaft *E* to rotate 1/100

revolution when locking plunger *B* is engaged. In order to obtain the proper tooth contact in this gear train, gears *M* and *O* are of the spiral type. Both members *I* and *J* are held in place by means of the washer *T* and the cap *U*, which is secured to the end of shaft *E* by means of a fillister-head screw.

To facilitate counting the holes in the dial while indexing a piece of work, three pointers like that shown at *P* in Fig. 2 are employed. The bores of the rings on these pointers are mounted on the collar *Q* (Fig. 1) which, in turn, is a slip fit on the sleeve *G*. The springs *R* provide the required pressure against the pointer rings to keep the rings in the stationary position to which they are set relative to the indexing plate. Two of these pointers mark the position of two holes in the indexing dial, while the other is opposite a line marked on plate *J* to show the position of plunger *A*. (See Fig. 2.)

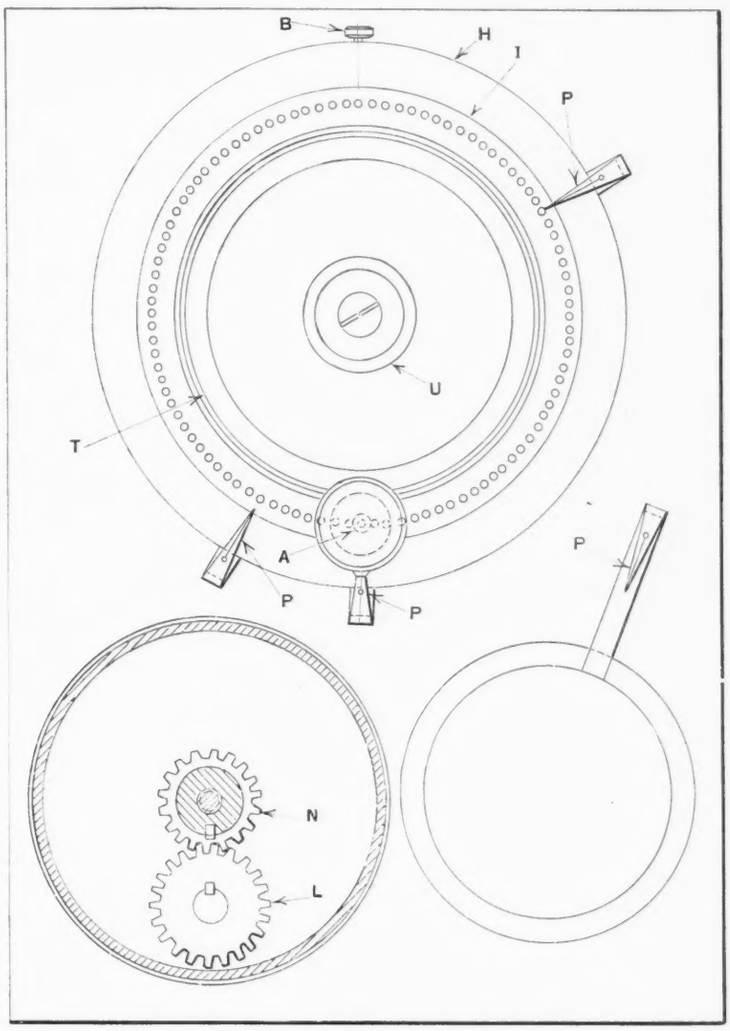


Fig. 2. End View of Head Illustrated in Fig. 1, Showing Method of Setting Pointers to Index the Work

To illustrate the action of this device, suppose it is required to index a piece of work so that fifty-seven equal divisions may be obtained. With pin *S*, Fig. 1, engaging a hole in the indexing dial and with the plunger *A* disengaged from the dial, one revolution of the plunger about the shaft *E* will cause the epicyclic gear train to turn the shaft 1 100 revolution. The shaft, in turn, will cause the worm to rotate the worm-gear and work $\frac{1}{100} \times \frac{1}{40} = \frac{1}{4000}$ revolution. If the plunger is rotated only 1/100 revolution about shaft *E*, or the distance between two adjacent holes in the indexing dial, then the work will rotate 1/400,000 revolution. Thus, to rotate the work 1/57 revolution, plunger *A* must pass over $\frac{400,000}{57}$ or 7017 31/57 holes, say, 7018 holes, the error resulting from using round numbers being so slight it may be disregarded for ordinary work.

To move the plunger over 7018 holes, however, would entail a great deal of labor and time, as it would have to be rotated more than seventy times. It was to eliminate this condition that the device was designed so that the epicyclic gears could be locked. In order to lock them, the plunger *B* is first raised, which withdraws the cam surface on the plunger and allows the spring-actuated pin *S* to leave the hole in the indexing dial. Plunger *A* is then pushed into an adjacent hole in the dial, locking the dial to the shaft *E*, after which plunger *A* is rotated seventy holes. It is then disengaged from the indexing dial and plunger *B* depressed to force pin *S* into the dial. Plunger *A* is now rotated a distance equal to eighteen holes, the last one of which it is allowed to engage so as to lock the mechanism during the milling operation.

The three markers *P* are set to assist in counting the holes while indexing the fifty-seven divisions. It will be seen from the preceding paragraphs that the first two figures of the number 7018 indicate the number of holes over which plunger *A* moves when the epicyclic gears are in their locked position, the last two figures indicating the number of holes over which the plunger passes when the gears are in operation.

Divisions designated by angles are easily indexed with this head. For example, let us assume that it is required to index work to an angle of 73 degrees 29 minutes 42 seconds. First divide 360 degrees by the required angle to obtain the equivalent number of divisions; thus:

$$\frac{360°}{73°\ 29'\ 42''} = \frac{1{,}296{,}000''}{264{,}582''} = 4.8983 \text{ divisions}$$

which corresponds with the number 57 in the preceding example.

Therefore, to rotate the work $\frac{1}{4.8983}$ revolution, or 73 degrees 29 minutes 42 seconds with pin *S* disengaged from the dial, plunger *A* would have to pass over $\frac{400{,}000}{4.8983} = 81{,}661$ holes. However, by making use of the locking arrangement, the pin *S* is engaged and the plunger held out of the dial *I* while the work is partly indexed by rotating plunger *A* about shaft *E* eight times plus 16 holes. The pin is then disengaged and the plunger entered into a hole in the plate *I*, after which the plunger is moved 61 holes in the same direction as before.

Speeds and Feeds for Drilling

In a paper recording a series of very thorough experiments on thrust and power for drilling, presented before the recent annual meeting of the Society of Automotive Engineers at Detroit, O. W. Boston, professor, College of Engineering, University of Michigan, and C. J. Oxford, chief engineer, National Twist Drill & Tool Co., gave some interesting information relating to recommended speeds and feeds for drills ranging in diameter from 1/16 to 2 inches. These speeds and feeds are those recommended by the National Twist Drill & Tool Co., Detroit, Mich. The recommended peripheral speed, in feet per minute, for high-speed steel drills is indicated directly under the name of each material listed, and the number of revolutions per minute for each drill size and material is given in the body of the table.

Speeds and Feeds for Drills of High-speed Steel

Size of Drill, Inches	Feed per Revolution, Inches	Bronze, Brass	Alloy-Steel Drop-Forgings	Cast Iron	Tool and Carbon-Steel Drop-Forgings	Mild Steel	Malleable Iron	Cast Steel	Hard Cast Iron
		Feet per Minute							
		300	50	140	60	120	90	40	80
		Revolutions per Minute							
1/16	0.003	18,320	3,056	8,554	3,667	7,328	5,500	2,445	4,889
3/32	0.0035	12,212	2,038	5,702	2,442	4,884	3,666	1,628	3,258
1/8	0.004	9,160	1,528	4,278	1,833	3,667	2,750	1,222	2,445
5/32	0.0045	7,328	1,221	3,420	1,465	2,934	2,198	976	1,954
3/16	0.005	6,106	1,019	2,852	1,222	2,445	1,833	815	1,630
7/32	0.0055	5,234	872	2,444	1,047	2,094	1,570	698	1,396
1/4	0.006	4,575	764	2,139	917	1,833	1,375	611	1,222
9/32	0.0065	4,071	678	1,900	814	1,628	1,222	542	1,084
5/16	0.007	3,660	611	1,711	733	1,467	1,100	489	978
11/32	0.0075	3,330	555	1,554	666	1,332	1,000	444	888
3/8	0.008	3,050	509	1,426	611	1,222	917	407	815
13/32	0.0085	2,818	469	1,316	563	1,126	846	376	752
7/16	0.009	2,614	437	1,222	524	1,048	786	349	698
15/32	0.0095	2,442	407	1,140	488	976	732	326	652
1/2	0.010	2,287	382	1,070	458	917	688	306	611
9/16	0.0105	2,035	339	950	407	814	611	271	543
5/8	0.011	1,830	306	856	367	733	550	244	489
11/16	0.0115	1,665	277	777	333	666	500	222	444
3/4	0.012	1,525	255	713	306	611	458	204	407
13/16	0.0125	1,409	234	658	281	562	423	188	376
7/8	0.013	1,307	218	611	262	524	393	175	349
15/16	0.0135	1,221	203	570	244	488	366	163	326
1	0.014	1,143	191	535	229	458	344	153	306
1 1/8	0.015	1,017	170	475	204	407	306	136	272
1 1/4	0.016	915	153	428	183	367	275	122	244
1 3/8	0.016	833	139	389	167	333	250	111	222
1 1/2	0.016	762	127	357	153	306	229	102	204
1 5/8	0.016	705	118	329	141	282	212	94	188
1 3/4	0.016	654	109	306	131	262	196	87	175
1 7/8	0.016	610	102	285	122	244	183	81	163
2	0.016	571	95	267	115	229	172	76	153

* * *

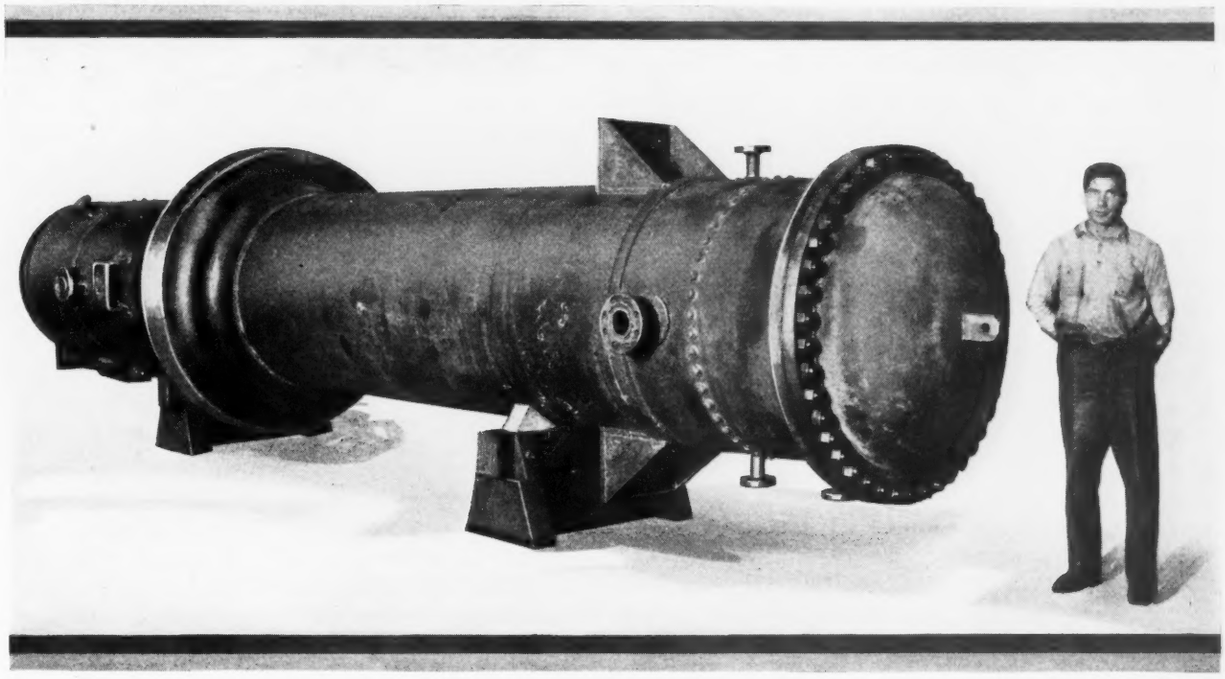
German Machinery in Eastern Europe

Ever since before the war, the German machinery manufacturer has looked upon eastern Europe as one of his best markets. This vast territory, which includes the Soviet Republics, Poland, Finland, and the new republics founded on the shores of the Baltic as the result of the Versailles treaty, absorbs increasingly greater amounts of foreign-made machinery each year—especially German.

Soviet Russia is the most important purchaser of German machinery, and exports to the Soviet Republics have shown a steady increase since 1925. The value of German machinery exports to Soviet Russia during the first six months of 1930, according to *Commerce Reports*, amounted to approximately $19,000,000, and to Poland $3,500,000, while the other eastern countries absorbed machinery to a value of about $2,750,000. Of the figures given in the foregoing about $6,000,000 represented exports of metal-working machinery, of which Soviet Russia absorbed the largest part. The exports of machine tools to Russia increased over 100 per cent.

Notes and Comment on Engineering Topics

Until lately, the use of arc welding in the fabrication of pressure vessels has not been permitted by either the insurance codes or the laws of many states. This restriction was due to the uncertainty of welds during the early development of the process. The shielded arc process, however, has been one of the steps that has made it possible, according to J. F. Lincoln, president of the Lincoln Electric Co., to produce economically welds having a tensile strength of from 60,000 to 75,000 pounds per square inch, and a ductility at least equal to that of rolled steel. This has removed the barrier that prevented the use of the electric arc in the fabrication of pressure vessels. The accompanying illustration shows one of twenty preheater exchangers for oil refinery service, in the fabrication of which arc welding has played an important part. These containers are subjected to a 200-pound pressure at 750 degrees F. They weigh 17 tons each and are 29 feet long.



A Preheater Exchanger, 29 Feet Long, for Oil Refinery Use, Operating at 200 Pounds Pressure, in the Fabrication of which the Arc Welding Process Played an Important Part

---

The total capacity of the water power plants in the United States on January 1, 1931, according to the annual report of the Department of the Interior, was 14,885,000 horsepower, an increase of 1,077,000 horsepower, or 7.2 per cent, during 1930. The greatest increase in the application of water power took place in New Hampshire, New York, South Carolina, Tennessee, Alabama, and Washington.

The huge castings to be used on the new Cunard liner now being built by John Brown & Co., Ltd., Clydebank, Scotland, are said to exceed in size and weight anything that has hitherto been made in the way of castings. The overall length of the stern frame is 112 feet, with an approximate finished weight of 180 tons. The rudder frame weighs 112 tons, and the four shaft brackets 215 tons. The castings were made by the Darlington Forge Co., Ltd. Special arrangements will be required for transporting the castings to Clydebank.

It is estimated that frame structures of all kinds in the United States are destroyed by the atmosphere to the extent of $45,000,000 annually. Lumber users are learning more and more to appreciate the value of creosoted lumber. The savings that can be effected by thus offsetting deterioration and decay cannot be overestimated.

EDITORIAL COMMENT

Last month it was our sad duty to record the passing of the founder of this journal, Alexander Luchars. The standards that he laid down when he started MACHINERY thirty-seven years ago have been rigidly adhered to during all the years that he remained the head of this publishing organization. And they will be adhered to as rigidly in the future. An engineering journal serves two interests—those of the reader and those of the advertiser. It was the founder's unalterable position that the advertiser was best served by a journal that never forgot its duty to the reader. This belief he recorded in an editorial published in November, 1894, the third issue of MACHINERY.

"Some intending advertisers," he wrote, "have asked us how many 'write-ups' we could give them during the year, and our answer was that—as the term is understood—we could give them none . . . Any advertiser who stops to consider the question will at once see that this rule is for his direct benefit as well as for the good of the paper, because the very first requisite of an advertising medium is that it will be read; and who reads 'write-up' papers? Nobody.

Standards of Trade Journalism Clearly Defined

" 'Write-ups' are the curse of trade journalism, for they never contain any news and seldom any information. They are impositions on the good faith and good nature of men who buy the paper for news, and they are tokens of dry-rot wherever they appear. Beware of papers liberal with 'write-ups.' Space in them is of little value, or it wouldn't be given away."

Industrial journals, guided by the ideals expressed by the founder of MACHINERY, have rendered an important service to the mechanical engineering industry while it passed through some of the early phases of its history. As the industry continues its steady advance in the future, they will render an even greater service. The progress of engineering will be more rapid, the application of new developments more intense, and the methods more scientific. It will be MACHINERY'S aim to aid this advance of the mechanical industries to the fullest extent possible.

The campaign against "white elephants" in machine shops, started by a leading machine tool builder, is worthy of the attention of every machine shop manager. There are some white elephants in almost every shop (machines and equipment costly to maintain, but not capable of producing in proportion to their maintenance expense)—elephants too costly to feed for the work they do.

There is only one thing to do with white elephants of this kind—get rid of them. They occupy space that is needed for other equipment that would give a better account of itself. Sometimes the repair costs run very high; and even though the machines have paid for themselves long ago, they may still be very costly.

Have You Any White Elephants in Your Shop?

This matter of obsolete equipment is not a question of opinion, it is a bookkeeping problem. In any plant with a reasonably good cost system, it is comparatively easy to determine when an old machine should be replaced for reasons of economy. American industry has prospered in the past because it has always been ready to adopt the new, when the new was better and more economical than the old. It will continue to prosper for the same reason in the future.

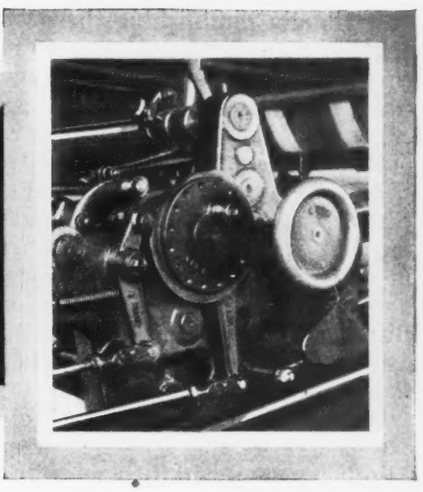
The effort to obtain the lowest possible production cost per piece has led many plant executives to produce in larger quantities at one set-up than is economical from a profit-making point of view. The shop executive is likely to overlook the fact that there are other factors to consider besides low production cost per piece. The articles or equipment manufactured must be disposed of within a reasonable time after completion; otherwise, the capital tied up in material and labor, storage charges, interest, and taxes will offset the savings made by manufacturing in large lots.

Low Production Cost is Not a Sure Sign of Profits

To determine what is the most economical quantity to produce at one set-up is not a difficult matter if the facts pertaining to sales are known with reasonable accuracy. Formulas have been devised for this purpose and are used by leading manufacturers. One of these was published in MACHINERY as far back as November, 1925, page 182, and in answer to an inquiry is republished this month on page 614. Whenever there is a question as to whether or not it is economical to put work through the plant in large-sized lots, this formula is likely to prove a reliable guide.

The subject is one that warrants close study. Many concerns have found themselves in financial difficulties because of too large inventories. Someone tried to save by manufacturing in too large lots.

Ingenious Mechanical Movements



Reversing Mechanism which Varies Point of Reversal

By OLAF ANDERSON

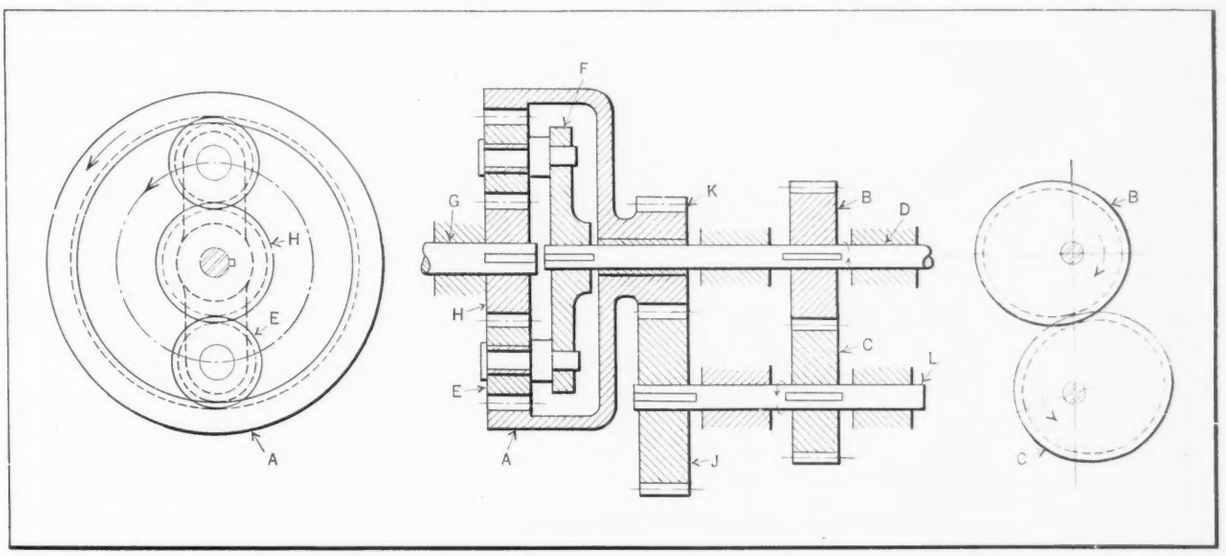
Some mixing machines of the agitator type, employed for mixing liquid or plastic materials, require a reversing movement of the agitators; at the same time, however, the point at which reversal occurs must advance uniformly. These combined movements may be obtained by means of the ingenious mechanism shown in the illustration.

Here the drive shaft *D*, rotating at a uniform speed, imparts the required movement to the shaft *G* through the action of a combination planetary and elliptical gear train. Although the planetary gear train is composed of the usual members, the manner in which the elliptical gears *B* and *C* vary the movements of these members is of unusual interest.

All three shafts *D*, *L*, and *G* rotate in stationary bearings, and owing to the ever changing radii of the elliptical gears at the tooth contact, an alternating accelerated and retarded movement is imparted to shaft *L*. This movement, in turn, is transmitted by spur gears *J* and *K* to the ring gear *A*. Now assume that the elliptical gears have rotated into the positions indicated in the end view at the right, and that the ratio of spur gears *J* and *K* and also the ratio (momentarily) of the elliptical gears is such that the velocity of the centers of pinions *E* is one-half that of the pitch line velocity of the ring gear. Then, according to the principle of epicyclic gear trains, the pinions will simply roll about and not rotate the spur gear *H*.

Now if the shaft *D* rotates in the direction of the arrow, the ratio of the elliptical gears at the tooth contacts will gradually change so that the movement of shaft *L* and ring gear *A* will be retarded. Therefore, as the pitch line velocity of the ring gear decreases, the velocity of pinions *E* relative to the spider *F* will also decrease, and the lag of these pinions will cause the gear *H* and shaft *G* to rotate in the same direction as shaft *D*.

This movement of shaft *G* will be accelerated until the elliptical gear *B*, whose engaging radius



Planetary Gear Train which is Given a Variable Movement by Elliptical Gears to Reverse the Movement of Shaft G

is gradually diminishing, has rotated through an angle of 90 degrees. At this point the ratio of the elliptical gears is at its minimum and as they continue to rotate, the ratio increases. This has the effect, through the movement transmitted to the pinions, of retarding the angular movement of gear *H* and shaft *G* until the elliptical gear *B* has passed through another 90-degree angle. At this time, the elliptical gears are once more (momentarily) in a position where the pinions roll about but do not rotate gear *H;* and, on further rotation of the elliptical gears, the velocity of the pinions will be gradually increased with respect to spider *F*, thus reversing the angular movement of gear *H* and shaft *G*. This movement of shaft *G* will be accelerated during a 90-degree movement of the elliptical gear *B* and then retarded through the next 90 degrees, at the end of which time the point of reversal has again been reached and the mechanism has passed through a complete cycle.

Referring to the end view at the left, it is obvious that the movement transmitted to the pinions during the first half revolution of the elliptical gears is slower than the movement transmitted during the second half; and since the velocity of these pinions governs the amount of angular movement of shaft *G*, then the angular movement of this shaft, in a counter-clockwise direction, is less than that in a clockwise direction. Therefore, the point of reversal of the shaft *G* will vary or advance about the shaft center an amount equal to the difference in these two angular movements.

By varying the ratio of the spur gears *J* and *K*, the advance of the reversal points may be increased or diminished to suit the requirements; or in case no variation of the reversal point is required, the same procedure may be followed. This type of mechanism, owing to its retarding and accelerating movements, is particularly desirable where reversal must take place without shock.

* * *

Planetary Type of Crank Motion for Obtaining Dwell

By C. H. VAN FOSSEN

In attempting to bend a stranded copper cable into a U-shape by means of a kind of wing die, it was found, while experimenting with a punch press, that a distinct stop or dwell was required at a certain point in the bending stroke to permit the copper to set. If the dwell was omitted, a springing back of the metal occurred, resulting in variations in the form of the bent section. This dwell had to take place before the end of the stroke, because the latter part of the stroke was utilized to eject the formed piece.

A special machine was designed to actuate the slide from which the bending die receives its motion. This operating slide also requires a dwell at the top of the stroke to allow time for inserting unbent parts into the die, so that the machine can be operated continuously instead of using a single-stroke clutch and tripping device. The planetary type of crank motion used causes a crankpin to follow, during the dwelling periods, an arc having a radius equal approximately to the length of the connecting-rod, so that the crank end swings without transmitting motion. Fig. 1 shows the general arrangement.

The housing *A* contains shaft *C*, which is driven through worm-gearing and carries a crank disk *D*. An internal gear *H* having 120 teeth is bolted to housing *A* and meshes with a 24-tooth planetary pinion *J* attached to the eccentric crankpin *E;* consequently, when crank disk *D* revolves, pinion *J* and the crankpin revolve around their own axis and also around shaft *C*. These combined rotary movements modify the motion imparted to slide *G* and cause the axis of the pin *E*, to which connecting-rod *F* is attached, to follow the path indicated by the heavy line *d*, Fig. 2.

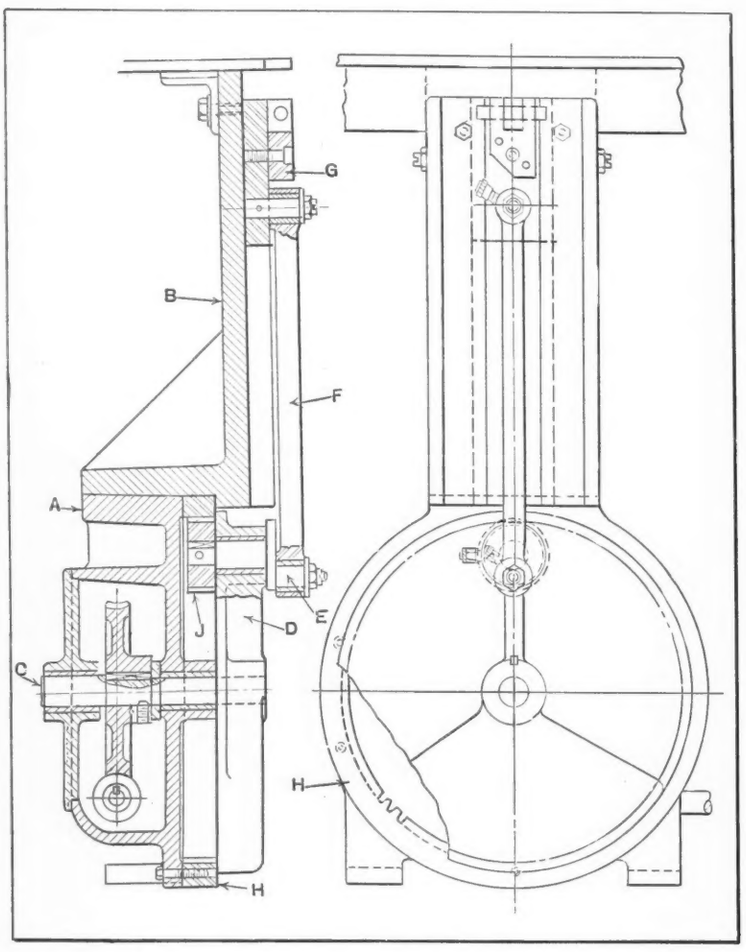


Fig. 1. Planetary Type of Crank Motion for Obtaining Dwell of Bending Die

The curve in the upper right-hand corner of Fig. 2 illustrates how the action of the driven slide is changed during one complete cycle. The cycle begins at a point representing the top of the stroke of the slide. The vertical dimensions on the chart represent the stroke, in inches, and the horizontal dimensions, the time in seconds. One revolution is represented as 3 seconds, because the machine is designed to run about 20 revolutions per minute.

The relative positions of the internal gear H and the pinion J (Fig. 1) are indicated in Fig. 2 by dot-and-dash pitch circles H_1 and J_1. The radius of the eccentric crank E is considerably less than the pitch radius of the pinion, which causes the axis of the eccentric crankpin to describe a five-lobed curve d. The dwell of the driven slide at the top of the stroke occurs between points a and b on the chart and during about 6/10 of a second. This dwell is due to the fact that the length of the connecting-rod equals the radius of an arc which approximates that part of the crankpin path from e to f. As the lower end of the crankpin swings from e to f it transmits only a slight movement, and there would be none at all if this portion of curve d were a perfect arc with a radius equal to the connecting-rod center-to-center length. It is the dwell at this point that is utilized for removing the work and inserting unbent blanks.

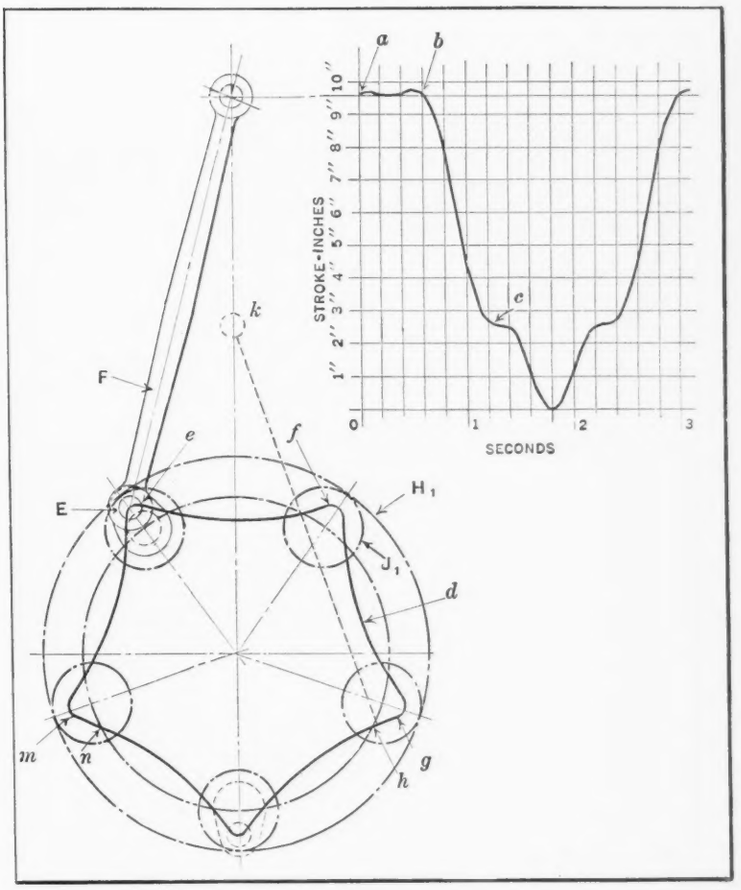


Fig. 2. Path Followed by Eccentric Crankpin, and Chart Showing Dwelling Periods

The pause during the down stroke to allow the metal to set after bending occurs between points g and h where the curve d is practically tangent to the arc of the connecting-rod. This pause or dwell is represented on the chart at c, and at this time, the upper end of the connecting-rod is at k. An unnecessary dwell is made during the return stroke between points m and n, which correspond to g and h, but this slight delay in the upward movement does not affect the practical working of the mechanism. The entire device is located under a table about 2 feet square, which indicates that it is quite compact.

* * *

A Clearing House for Machine Design Data

Teachers of machine design in colleges and technical schools in the United States have formed a clearing house for the purpose of exchanging solutions to problems in machine design, research data, ideas as to methods of teaching machine design, and other information of interest in connection with this work. Material contributed by the members is sent to the chairman, Professor Frank L. Eidmann of Columbia University, New York City, and mimeographed copies are distributed to the members.

Special Alloys for Automobile Engines

The use of aluminum in automobile crankcases is decreasing, but aluminum and magnesium alloys will be used extensively in the crankcases of aeronautic engines, according to a statement made by Frank Jardine, of the Aluminum Company of America, at a meeting of the Dayton Section of the Society of Automotive Engineers.

The demand for increased automobile speed and acceleration has resulted in larger and more powerful engines, which has made it necessary to increase the weight of the entire vehicle. Mr. Jardine asserted that, instead of increasing the size of the engine, it would be better to reduce the weight of the car, and as indicating a way of doing this, told of a car in Cleveland that has a cast aluminum body. It has a 132-inch wheel-base and weighs about 3000 pounds, as compared with 4800 pounds for a corresponding car of conventional design.

Some recent experimental developments in new alloys include a cast-iron alloyed with monel metal, resulting in a material that expands almost the same amount with heat as an aluminum alloy that is much used in engine pistons. This combination promises a solution of the problem of using aluminum pistons in cast-iron cylinders without allowing too much clearance or having the pistons expand so much as to seize in the cylinders.

The Shop Executive and His Problems

Superintendents and Foremen are Invited to Exchange Ideas on Problems of Shop Management and Employe Relations

THE article "Why the Jobbing Shop is Unprofitable," by Raymond H. Dauterich in February MACHINERY, page 437, brings up a subject of vital importance to every jobbing shop and manufacturer of special tools and machinery. This branch of the industry is in a bad state simply because so many of those engaged in it make bids that do not cover all their legitimate costs, to say nothing of a reasonable return on the investment.

If it could be established as a trade custom that in all cases of competitive bidding, all bidders and bids should be made known after the business has been placed, it would do much to improve the present conditions in the special tool and machinery field. The same practice should be followed for jobbing shop work generally. There is no reason why everything should not be open and aboveboard after the order has been placed.

J. H. STERNBERGH

Are Orders Always Orders?

Should the orders given by a foreman or superintendent be observed by the workman 100 per cent, and no questions asked, even though the workman knows that strict fulfilment of the order might mean a total loss of time and product? If he refuses to obey an order, he will jeopardize his job. He may do so even if he points out in a courteous way that his superior is wrong.

Men who have had military training argue that orders from someone in authority should be carried out, regardless of the results. But is the workman entirely blameless when he knows that the order is wrong?

I have observed two cases in point recently. In one case, the attendant in a small power plant noticed one morning, before his superior arrived, that oil was leaking from the main bearing of the generator. He concluded that the reason was overoiling and as soon as his chief arrived, notified him. The chief, too, thought that the trouble was overoiling, and ordered the supply of oil cut down. This was done at once and the boss left. He is a man of stern disposition, and the attendant knew that he would discharge him at once for any violation of his orders. Later in the day, the attendant discovered that the bearing was becoming heated excessively, but he was afraid to increase the oil supply, because he had been ordered to cut it down. The bearing burned out and closed down the plant for two hours.

A conference of officials resulted, and the attendant was questioned: "Would you have taken a sledge and broken that generator bearing if your chief had ordered you to do so?" The man replied that he certainly would, and he immediately lost his job.

In the second case, the workman refused to do as he was told. The order involved certain changes on the wings of a high-powered airplane which he knew would be absolutely wrong and would fail to pass inspection; but the superintendent who had ordered the work done discharged the man for not carrying out orders. The man took the case higher up and was reinstated through the intervention of the president; but, of course, now a bitter feeling exists. When shall a man obey orders and when shall he not?

RAYMOND H. DAUTERICH

How Much Education Should the Employer Pay for?

Commenting on the article on page 528 of March MACHINERY relating to aid given employes by their employers in taking evening courses, I would make the following suggestion: Would it not be of advantage to the employer to pay, say, one-half of the tuition fees charged for courses pertaining to the line of work in which the employe is engaged? The initiative would rest with the employe, who would not be urged to take the course, but who would be informed that if he wanted to take the course, he would receive assistance. The employer would gain in loyalty and good will, and would also obtain practical benefits from the increased knowledge of the employe. It should, of course, be stipulated that the employe must make a satisfactory attendance record.

E. L. FAIRALL

Taking Charge of a Department

Commenting on the article "Taking Charge of a Department" in February MACHINERY, page 437, it is the opinion of the writer that it is not always effective for the new foreman to try to convey to the men of his department that he will do his best to get along agreeably with them and to make them feel that he will be a supervisor, not a "boss."

Genuine leaders of men obtain the best results when the men under them realize that they are the boss and that their right to the title is that they know the job that they administer as bosses. In my own experience, I have found that a reserved attitude is the best for anyone taking charge of a de-

partment. The best qualifications are real experience, ability, and a sense of fairness. Because a man is the boss, it is not necessary for him to be overbearing.

But why bring in a man from the outside? In a shop of any size, it is usually possible to train a man for an understudy—an assistant foreman. No foreman of real ability need be afraid of preparing a man to take his job when the time comes for him to step into bigger responsibilities.

CHARLES H. WILLEY

How a Foreman Can Best Instruct His Men

The best way a foreman can give instructions to the men in his department is by first trying to give them a general idea of what is wanted, so that they will have a fair conception of the reason for doing what they are asked to do. Unless you know the reason for doing a thing, you cannot apply your intelligence in doing it. When the general purpose has been made clear, the foreman should explain, step by step, what is wanted, how it is to be done, where it is to be done, why it is to be done in the way specified, and when it is to be completed. The man who is to do the work should be asked to repeat the instructions to make sure that they are clearly understood. If there are several steps in the operation, each step should be explained separately, and the man who is to do the work should repeat the instructions for one step at a time.

After these instructions have been given, the man should be left alone to perform at least the first step of the work without interference. It is extremely annoying to have someone standing over you while you are getting a job under way. When a sufficient length of time has elapsed, however, it is well to go back and see that the job is progressing as it should.

JOHN A. HONEGGER

Know Your Handbook

Referring to the article "Using a Handbook to the Best Advantage," on page 442 of February MACHINERY, the following experience may be of interest. For some time, I have had occasion to make a great many calculations involving the conversion of circumferences of a given length into the corresponding diameters. The circumferences were generally given in even numbers, making the diameter a decimal fraction. The method that I used for a long time was to look up the nearest circumference in the tables on pages 55 to 66 of MACHINERY'S HANDBOOK, interpolating as nearly as possible to obtain the exact diameter. Then, by mere chance, I came across the table on page 71 in the HANDBOOK, which gives the circumferences in even numbers—the exact form in which the information was needed.

Now this table has been in this book during all the years that I have owned it, but it never occurred to me that there was such a table, and I stumbled upon it by accident. This emphasizes the point that handbook users should go through their handbooks page by page to find out exactly what is in them and to locate the material that may be of use in daily work.

EDWARD HELLER

Competitions for "No-Accident" Records

Competitions in accident prevention work do not always bring about the results primarily aimed at. One object should be to conduct accident prevention work in such a manner that anyone injured will make a report and obtain first aid. Any plan that creates rivalry between departments may defeat this object.

The average worker wants to be a good sport, and rather than cause his department to lose its record in the competition, he will not report a minor accident. Hence, "no-accident" record competitions are not so sound as some executives seem to think, because nine out of ten men will keep quiet about minor accidents to avoid being blamed for spoiling the record.

Competitions can be organized on a different basis. In one plant, a safety committee composed of the superintendent, employment manager, and two foremen inspect the departments of the plant once a week. The department that has the fewest hazards that may lead to accidents, and the largest number of machines kept up satisfactorily, is commended by a posted notice. This method, in conjunction with explicit explanations of dangerous practices, will do more to reduce the number of accidents than a competitive plan.

HARRY KAUFMAN

Training Teachers for Trade Schools

A great deal has been said recently about apprenticeship training, but little thought has been given to the growing demand for competent teachers in trade schools. This demand has been met successfully in some state trade schools by establishing teacher training courses.

The purpose of these courses is to teach men, with years of practical experience, the art of teaching. Instructors in the state trade schools in Connecticut are men of thorough practical knowledge, who are given a course of training to become trade school teachers. During the latter part of their training, they are placed in charge of a class of boys, under the guidance of regular teachers. In this way, the supervising teacher, by observation, may be able to determine whether the new man is competent.

Everybody does not have the ability to teach. Comparatively few are so gifted, and it is for the development of these few that the training course has been established. It is very important to provide the means for the proper selection and development of men best fitted for the work of teaching.

J. E. FENNO

New Cam Grinding Device of British Design

Constant Angular Velocity of the Cam Being Ground is Obtained by a Combination Lateral and Parallel Movement of the Fixture

AN attachment has recently been patented by the Churchill Machine Tool Co., Ltd., Manchester, England, that is intended for use on either cam grinding or standard cylindrical grinding machines. With this device, a uniform angular velocity of the cam is maintained, so that the surface speeds at the grinding contact are the same on both sides of the cam peak.

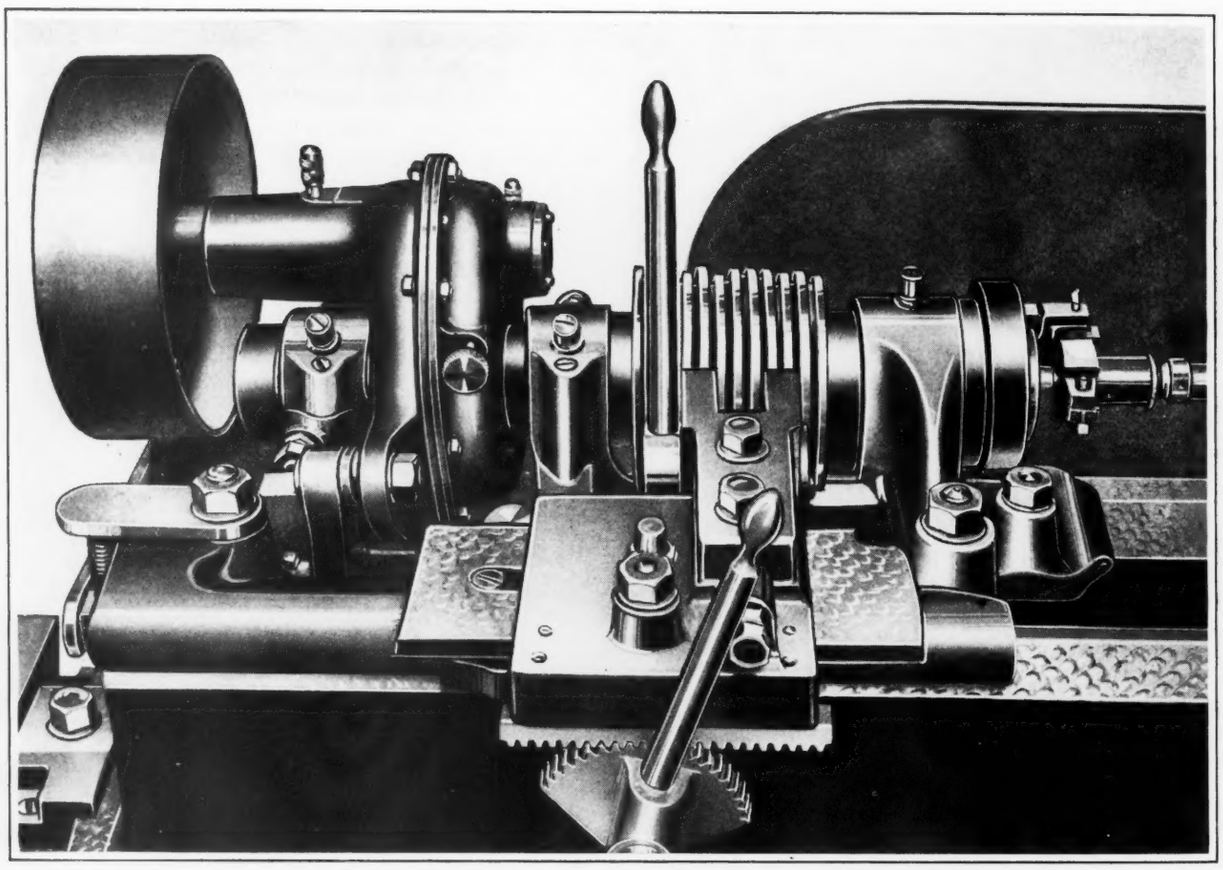


Fig. 1. Rocking Table Equipped with Individual Master Cams by Means of which Camshaft Surfaces are Ground at a Uniform Angular Velocity

Lateral movement for grinding the cam contour is obtained by means of a rocking table indicated at *A*, Fig. 2, which oscillates about the trunnions *B*. Movement is imparted to the table by the master cam *C*, which rotates with the spindle *D* and engages a roller *E* in a bracket connected to the fixture base. The trunnions rotate in bearings integral with the base, which, in turn, is clamped to the machine table at *F*.

Provision is made for supporting the work between centers by equipping the rocking table with a headstock and tailstock. Rotary movement is imparted to the headstock spindle by gears *G* and *H*, which, in turn, are rotated by the pulley *J*. The pulley is driven from either an overhead countershaft or a self-contained swinging arm mechanism carrying belts which transmit the drive from the main drive shaft.

The casing enclosing the gears oscillates independently about the headstock spindle, and is maintained in a vertical position by the link *K*. One end of this link is pivoted to the gear casing and the other to the base. Thus it is apparent that a movement is imparted to the gear casing parallel to the line passing through the center of the gear *G* and the upper pivot of the link. In this way, planetary movement of the driving and driven gears is eliminated, resulting in a constant angular velocity of the driven gear.

Typical Applications of the Cam Grinding Device

In Fig. 1 is shown a typical set-up in which the principle of the design described is applied. Here the cam surfaces on an automobile camshaft are being ground. However, instead of employing a single master cam, as illustrated in Fig. 2, a group

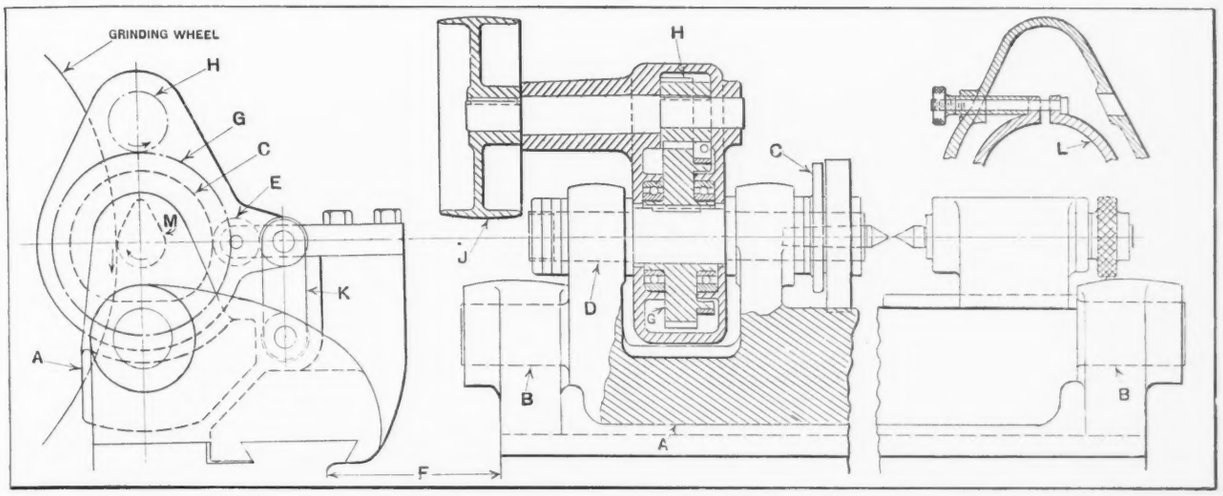


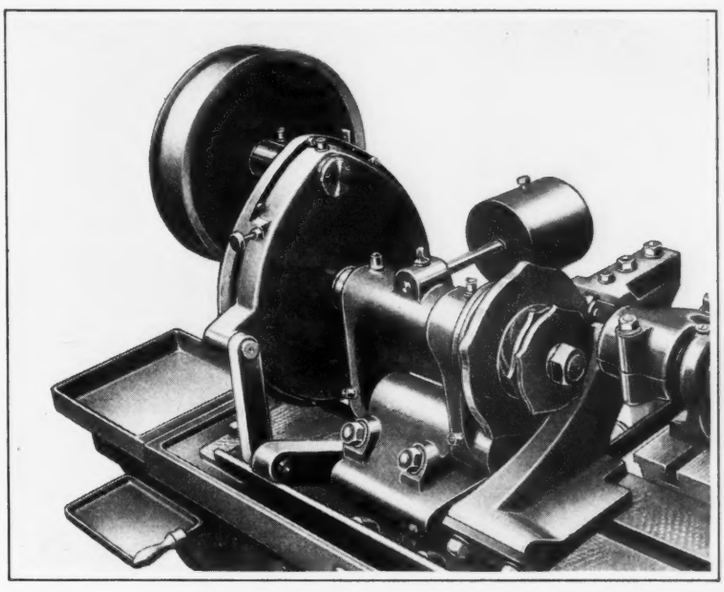
Fig. 2. General Construction of the Rocking Table Illustrated in Fig. 1, Showing How Table and Gear-case are Oscillated by a Master Cam

of master cams equal in number and corresponding to those on the camshaft are used. They are mounted on the work-spindle and are located in their proper radial position with respect to the cam contours on the camshaft.

Provision is made to facilitate quick positioning of the follower roll opposite each master cam. The roll is designed to rotate in an eccentric housing to which a lever is secured, the whole being mounted on a slide which may be moved in a direction parallel to the center line of the work-spindle. The slide is operated by a second lever through a rack and segment gear. To move the roll from one master cam to the next, the operator first swings the eccentric lever, which withdraws the cam from contact with the grinding wheel and the roll from contact with the master cam. The second lever is then shifted, causing the slide to be moved along until the roll is opposite the required master cam, where a spring-loaded device locates the slide in the correct position. The eccentric lever is now returned to its original position, and the corresponding surface ground.

Another set-up in which a single master cam is employed is illustrated in Fig. 3. In this case, the part to be ground is a double cam used in a radial aircraft engine. Only one master cam is provided, as both cam contours are the same. However, before grinding the second contour, the master cam must be indexed to correspond with the cam to be ground. In place of the spring used in the set-up shown in Fig. 1, a weight is used to keep the master cam against the follower roll. Either of the two set-ups described can be arranged to be driven from the main shaft at the rear of the grinding machine.

Fig. 3. In This Set-up for Grinding Ring Cams for Aircraft Engines, One Master Cam is Indexed for Grinding the Contours of Both Cams



* * *

Several years ago, the research department of the American Manganese Steel Co., Chicago Heights, Ill., developed the Amsco manganese steel welding rod for the company's own use. The results were so satisfactory that this welding rod is now being marketed for the reclamation of castings and the repair of machine parts. Patents have been applied for on the composition of the welding rod, the manganese content of which is from 13 1/2 to 14 per cent. The surface obtained by the use of the welding rod is equal in wear resistance to manganese steel. It may be used for building up manganese and other steel castings.

Flexible Shafts and Their Application

Construction, Flexibility, and Power-transmitting Characteristics of Different Grades and Sizes of Flexible Shafts

By JAMES M. TALBOT
Manager, Industrial Division
The S. S. White Dental Mfg. Co.

MORE than thirty million feet of flexible shafting are used annually. Applications of flexible shafts are found in a variety of equipment ranging from light hand tools that must be manipulated with great delicacy to rugged boiler tube cleaners built for hard, rough service. The unusual power- and motion-transmitting problems involved in the construction of many new machines and devices have been solved by the application of flexible shafts. Such applications include oil burners, talking motion picture equipment, and various types of speed indicators in which reliability is a prime requisite. Among the latter applications are the flexible shafts of the tachometers used in the two record-breaking flights of the Curtiss Robin plane. These flexible shafts made, respectively, approximately 37,800,000 and 50,000,000 continuous revolutions without any noticeable effect on their operating efficiency.

Notwithstanding the widespread use of flexible shafts, comparatively few engineers and designers are familiar with recent improvements in this product or have available the data and information necessary for its most effective application. It is the object of this article to give in as concise form as possible the basic information needed to visualize the possibilities of flexible shafting and to work out actual applications.

General Construction of Flexible Shafting

The flexible shafts described in this article are made by the Industrial Division of the S. S. White Dental Mfg. Co., 150 W. 42nd St., New York City, in sizes from 0.041 to 0.750 inch in diameter. The shafts are built up of steel wires, wound in a varying number of superimposed layers, as shown in Fig. 1.

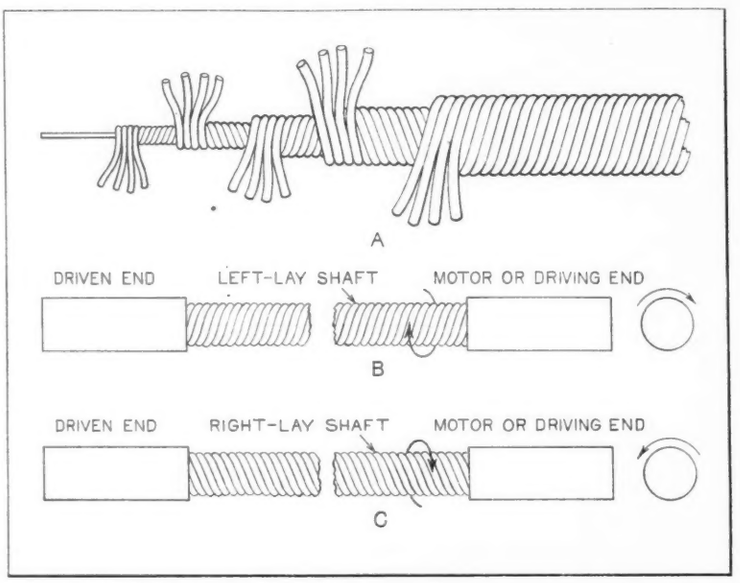


Fig. 1. (A) Section of Flexible Shafting Constructed of Superimposed Layers of Wire Wound in Opposite Directions; (B) Shaft with Outer Layer Wound Left-hand for Best Results when Drive is Right-hand, as Indicated by Arrow; (C) Shaft with Outer Layer Wound Right-hand for Best Results when Drive is Left-hand

The direction of the lead or pitch of the successive windings alternates and the wires are of graduated sizes, increasing with the layers. The material is a special grade of steel music wire of high tensile strength, and may be wound in any number of layers according to the type and size of flexible shaft desired. Shafts of widely varying characteristics are produced by different combinations of wires, and by differences in the number of layers and the subsequent heat-treatments to which they are subjected.

Properties of Two Regular Grades

All the flexible shafts described here are regularly made in two general types, classified as Grade H and Grade S, irrespective of their diameter. The Grade H flexible shaft has high torsional strength, or resistance to twisting strain, and is adaptable to the majority of uses. Grade S shafting has greater flexibility than Grade H and is usually employed where extreme flexibility is the deciding factor. The difference in torsional strength is shown in the accompanying table. Various other grades are made for special applications.

Right- and Left-lay Shafts

Flexible shafts are wound for maximum efficiency when rotating in one direction only. The pitch direction of the outer layer of wires determines the direction of rotation in which the shaft will give the best results. A shaft should be rotated so that the tendency will be to tighten up the outer layer. A shaft to be operated in a right-hand direction should have its outer layer wound oppositely, or left-hand. Therefore, for right-hand driving, a left-hand or "left-lay" shaft should be used, and for left-hand driving, a right-hand or "right-lay" shaft is better. The correct direction of rotation

for best results with right- and left-lay shafts is indicated by the arrows in Fig. 1. All sizes are manufactured in both right- and left-lay types, and although either type can be run in both directions when necessary, greater efficiency is obtained by using the proper lay of winding when the rotation is in one direction only.

End Connections for Shafts

Flexible shafting is manufactured in long lengths and cut to the required length while the wires are under tension. This is accomplished by brazing or swaging the wires solidly together where the cuts are to be made. Thus, a flexible shaft presents solid ends which may be soldered or swaged into metal end connections like the ones illustrated in Fig. 2. As this work requires special equipment, it is advisable that it be done by the manufacturers.

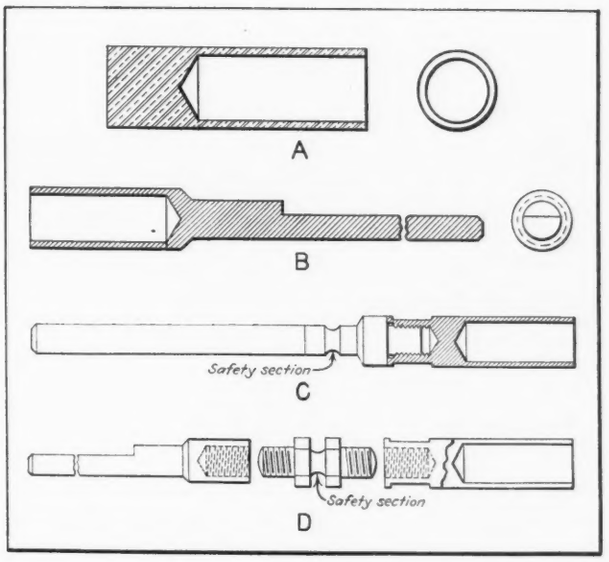


Fig. 2. Fittings into which Ends of Flexible Shafts are Soldered

Almost any combination of ends can be supplied on shafts of any required length. The ends may be forked, slotted, splined, square, flat, or threaded, and they may be made of any material desired. Some typical designs are shown in Fig. 2. At *A* is shown the solid-end type, which is usually made of brass. This type of end assures a true running connection at both ends of a shaft, and is made with standard outside diameters ranging from 5/32 to 7/8 inch to suit shafts from 0.110 to 0.750 inch in diameter.

The standard flat-end driving connection shown at *B* is made of steel. The drive, when this type of end is used, is provided with a pin *C*, Fig. 5, which makes contact with the flat side. This arrangement permits the shaft to have a limited sliding or endwise movement inside the outer case without interfering with the rotary driving motion.

Table of Torque Capacities of Flexible Shafts*

Grade of Shaft	Diameter of Shaft, Inch	Radius of Curvature, Inches: 20	15	10	8	7	6	5	4	Straight Shafts Only: Safe Torque Capacities in Pound-Inches	Straight Shafts Only: Torsional Deflection in Degrees Per Pound-Inches Per Foot Length of Shaft
		Safe Torque Capacities in Pound-Inches									
H	1/8	3.2	2.8	2.5	2.2	1.8	1.5	1.1	0.4	4.0	40.00
	1/4	16.0	14.0	11.0	8.7	7.1	5.0	2.0	...	20.0	2.30
	3/8	36.0	31.0	22.0	15.0	10.0	4.0	...	...	49.0	0.70
	1/2	53.0	44.0	27.0	14.0	5.0	...	...	...	78.0	0.24
	5/8	70.0	55.0	28.0	6.5	...	...	...	...	112.0	0.11
	3/4	86.0	60.0	28.0	...	...	...	...	...	152.0	...
S	1/8	2.0	1.8	1.7	1.5	1.4	1.2	1.0	0.5	2.3	45.00
	1/4	9.0	8.4	7.1	6.1	5.4	4.5	3.2	1.3	11.0	2.90
	3/8	20.0	18.0	14.0	11.0	9.2	6.6	2.5	...	26.0	1.60
	1/2	38.0	33.0	25.0	19.0	14.0	8.5	...	...	50.0	0.30
	5/8	54.0	47.0	34.0	23.0	16.0	6.3	...	...	75.0	0.16

Rules and Constants for Use with the Table Above

To Find the Horsepower that any shaft will transmit at a given speed, multiply its torque capacity, as given in the table, by the constant for the particular speed.

To Find the Torque in pound-inches that a shaft will have to carry when transmitting a given horsepower at a given speed, divide the horsepower by the constant for the particular speed. The size shaft needed can be found by referring to the table.

The data in these tables are based on the formulas:

$$H = \frac{2\pi T \times N}{33{,}000 \times 12} \quad \text{and} \quad T = \frac{H \times 33{,}000 \times 12}{2\pi \times N}$$

where T = torque in pound-inches; H = horsepower; and N = revolutions per minute; $\pi = 3.1416$.

Speed, R.P.M.	Constant	Speed, R.P.M.	Constant
500	0.008	3500	0.056
1000	0.016	4000	0.064
1500	0.024	4500	0.072
2000	0.032	5000	0.080
2500	0.040	5500	0.088
3000	0.048	6000	0.096

*Torques given in table apply to both right-lay and left-lay shafts when rotating in one direction only, that is, the direction that tends to tighten up the outer layer of wires. When rotating in opposite directions, their torque capacities are reduced from 20 to 50 per cent. The values given in the table are approximate, and are intended as a basis for selecting a shaft for trial purposes. They apply to shafts up to 25 feet in length.

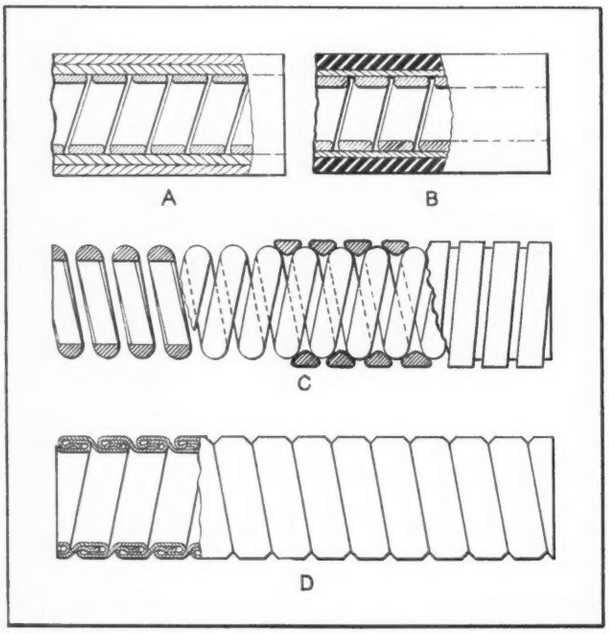


Fig. 3. Longitudinal Section Views of Different Types of Casings Used to Guide and Protect Flexible Shafts

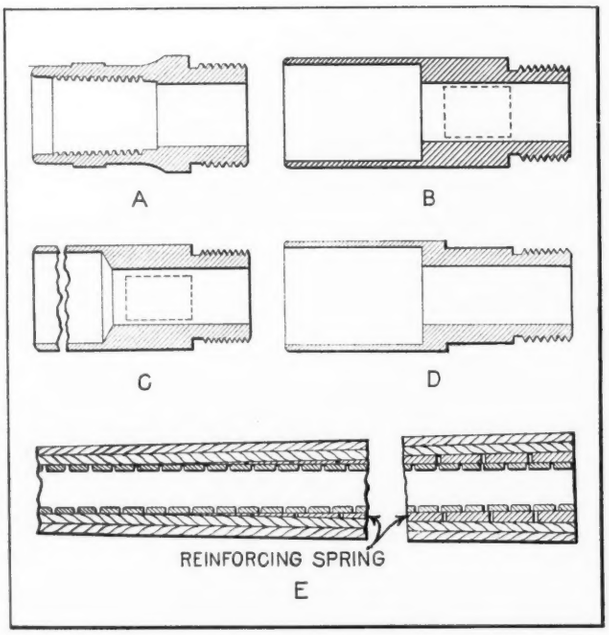


Fig. 4. (A, B, C, D) Longitudinal Section Views of Fittings Used to Secure Ends of Casings Shown in Fig. 3

At *C*, Fig. 2, is shown an end piece known as the "Safend." The removable driving part of this end has a section of reduced diameter, the torsional strength of which is somewhat less than that of the driving shaft. This reduced section will break before the shaft becomes overloaded, and thus protects the shaft from injury. Replacement is accomplished by simply removing what is left of the broken end and screwing a new end in place.

At *D* is shown a similar means of protecting the driving shaft by the use of a safety section known as the "Safelink." In this case, neither the driving end nor the shaft is injured when the "Safelink" gives way due to overloading.

Selecting a Flexible Shaft of the Proper Grade and Size

The amount of flexibility desired determines the grade of shaft to be used. When torsional strength rather than great flexibility is required, a Grade H shaft should be used. On the other hand, when flexibility is the important consideration, the Grade S shaft should be employed. Only when unusual conditions are encountered is it necessary to employ special grades.

The torque, or twisting force, that the shaft must transmit is the principal feature in determining the size of the shaft required. The torque is determined by the power to be transmitted and the speed at which the shaft is to operate. Thus the power transmitted is equal to the torque times the speed. The torque, therefore, equals the power divided by the speed. This relationship is expressed in the horsepower formula in the lower left-hand corner of the accompanying table.

Ordinarily, speeds of 1750 to 3600 revolutions per minute are recommended for flexible shaft operation. However, when properly applied, the shafts may be run at practically any speed, although it is recommended that a speed of not more than 500 surface feet per minute be used for large shafts. That is, 3.14 times the shaft diameter, in feet, times the number of revolutions per minute should not exceed 500. Obviously, the higher the speed, the less will be the torque on the shaft when transmitting a given horsepower. For this reason, it is preferable to run the shaft at the highest speed permissible under existing conditions.

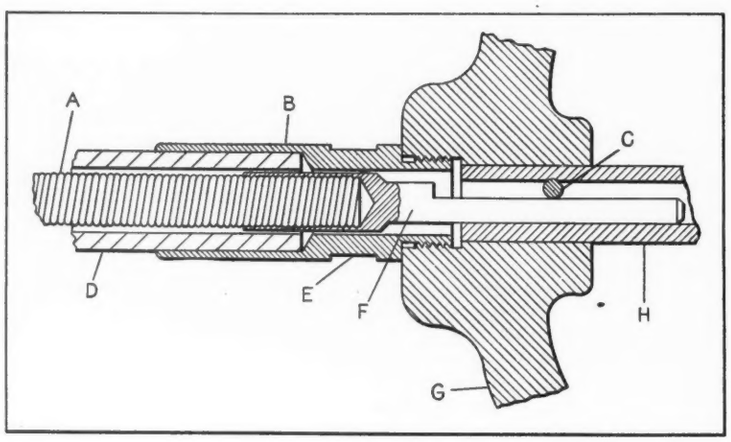


Fig. 5. Cross-section of Typical Flexible Shaft Drive at Motor Connection

The values given in the accompanying table apply to shafts up to 25 feet in length. Longer shafts can, of course, be used. There are cases where flexible shafts 50 feet long are being used for special purposes.

Practically every flexible shaft is provided with a

casing, which acts as a runway or guide for the shaft and protects it from dust and other foreign matter, as well as from injury. This casing is sometimes referred to as the "sheath" and also as the "tubing."

In some cases, shafts are used without a casing. This is permissible only when the shaft is of short length and is not likely to be covered with dust or dirt or to come in contact with anything. Casings are made of a variety of materials, including braided fabric, metal, leather, and rubber-filled materials. In practically every size, however, a metal winding forms the foundation over which the other material is laid.

In Fig. 3 are shown four different types of casings, each of which has been developed to suit certain operating conditions. The plain fabric casing shown at *A* is very flexible and comparatively light in weight. It is generally used on small portable flexible-shaft machines designed for light operations, when great flexibility is essential and also when neat appearance is a consideration. A metal spring serves as a foundation for the series of cotton yarn braidings. This type of casing is regularly made for shafts from 0.130 to 0.250 inch in diameter. At *A*, Fig. 4, is shown the type of metal coupling end employed. The fabric casing can be waterproofed with flexible varnish.

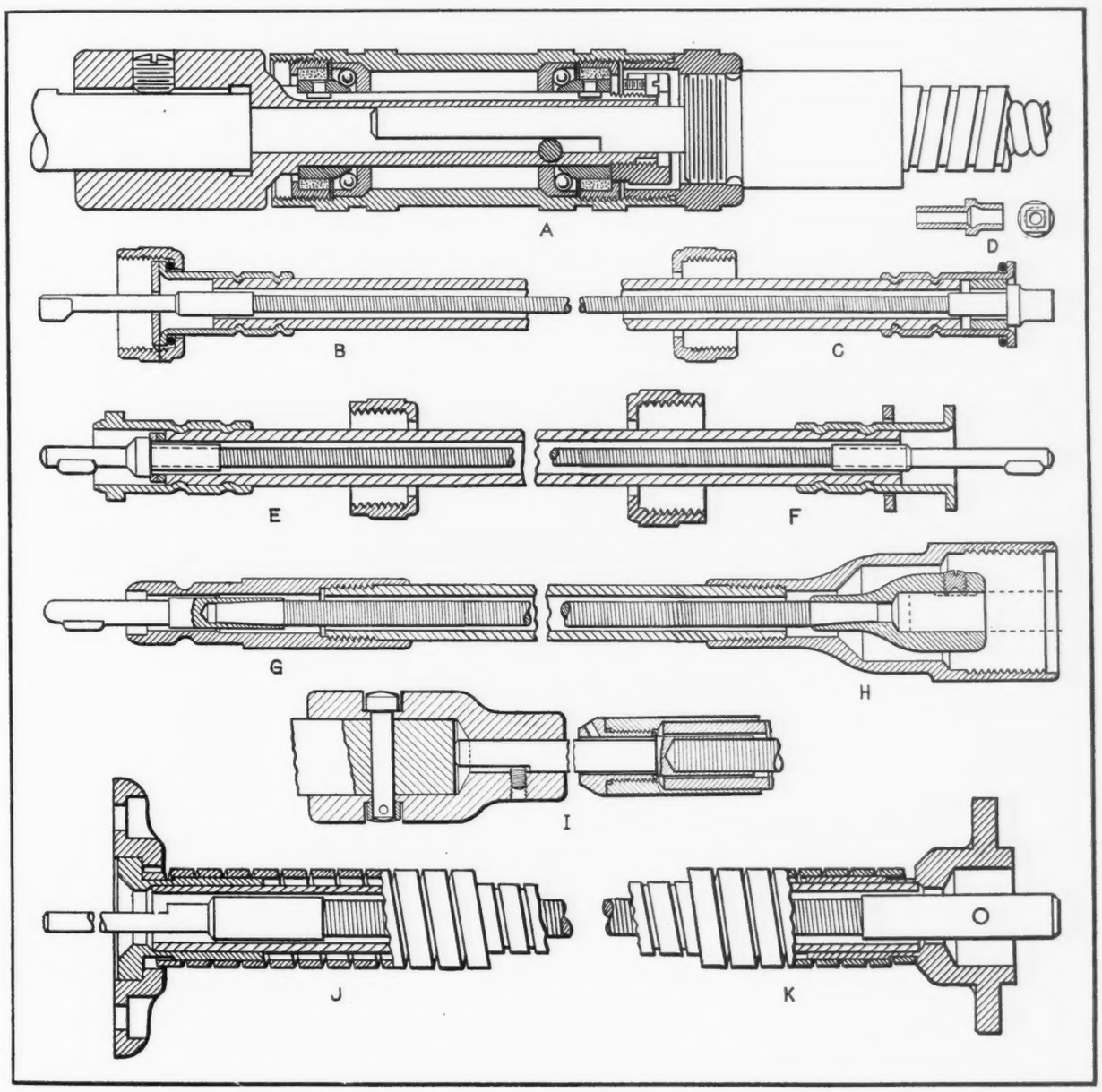


Fig. 6. Examples of Typical Flexible Shaft Driving Units with Various Types of End Fittings

For applications where the shaft will be flexed continually, the fabric casing can be supplied with a metal reinforcing spring at the point or points of greatest bending. This method of reinforcing fabric casing is illustrated at *E*, Fig. 4.

At *B*, Fig. 3, is shown the construction of a rubber fabric casing having exceptional durability. This casing has little tendency to shrink or stretch

and is oil- and water-tight. It is comparatively heavy and not so flexible as the plain fabric casing. For this reason, it is not so well adapted for very small hand tools, which require delicate manipulation, but is suitable for the heaviest work and is made by vulcanizing rubber and fabric over a specially heat-treated helical spring. It is made regularly in sizes suitable for shafts from 0.250 to 0.625 inch in diameter. The end used on this type of casing is shown at *B*, Fig. 4.

Construction of Metallic Casings

An inexpensive casing of a type that resists abrasion well and that is particularly adapted for such applications as speedometers, medium sized flexible shaft tools, etc., is shown at *C*, Fig. 3. In the middle sizes it is somewhat more flexible than the plain fabric casing. It is practically oil-tight and is generally given a black japanned or rustproof finish, although it can be finished in nickel plate if desired. This casing is made of two steel wires accurately wound together on a special machine. The inner wire is half-round in cross-section, and the outer one triangular with its shape conforming to the contour of the inner wire.

This type of casing is regularly made in sizes to accommodate shafts of from 0.180 to 0.625 inch in diameter. The end for this type casing is shown at *C*, Fig. 4.

A rugged casing particularly well suited for such applications as boiler-tube cleaners, locomotive speed indicators, etc., where extraordinary resistance to abrasion, vibration, and hard usage is of paramount importance is shown at *D*, Fig. 3. This interlocking type of metallic casing has a rustproof finish similar to galvanizing. A stiff supporting spring should be used over this casing at the point of bending, as it is likely to be kinked or broken if bent sharply, because of its stiffness. This type is ordinarily made in sizes suitable for shafts from 3/8 to 5/8 inch in diameter. The casing end is shown at *D*, Fig. 4.

Typical Shaft, Casing, and Casing End Combinations

In Fig. 5 is shown a cross-section view of the motor-driven end of a typical flexible shaft installation. The flexible shaft *A* is fitted with a standard flat end *F* which engages the driving pin *C* in the drilled spindle of the motor shaft *H*. The casing *D* is fitted with the casing end *B*, which is threaded to fit the tapped hole in the motor shell or machine frame *G*. Flats at *E* are provided so that the casing end can be screwed into place with a wrench. It will be noted that this assembly permits the shaft to slide back and forth in the casing and thus compensate for the relative movement between the shaft and casing which occurs when the shaft is flexed or when any stretching or shrinkage of the casing occurs.

In Fig. 6 are illustrated a number of typical flexible-shaft driving units consisting of the flexible shaft, casing, and casing ends. The combination shown at *A* is suitable for a wide range of applications. It is ready for direct attachment to the driving and driven spindles without requiring any machining. The end fittings are simply pushed on the spindles and fastened by means of set-screws. The casing ends are provided with long ball-bearing fittings which serve as the bearings for the drive shaft. This is a very handy unit for driving experimental machines and laboratory devices. It is made in sizes to take 1/4-, 3/8-, 1/2-, and 5/8-inch spindles.

At *B* and *C* are shown two types of end connections employed for the standard tachometer driving shafts on commercial airplanes. These are similar to the type built to government specifications and are interchangeable with the latter. The flexible shaft is 0.150 inch in diameter, and the outer casing is of the interlocked metallic type. At *D* is shown a cross-section of the driving end of the shaft. Although made specifically for driving tachometers, this shaft is also applicable where the driving requirements are similar.

The standard combination for driving automobile speedometers is provided with end connections such as shown at *E* and *F*. A rustproofed metallic casing is used for this drive. The flexible shaft may be of any grade or lay, and either 0.130 or 0.150 inch in diameter.

Another combination that is made in large quantities and is used extensively on portable tools for light drilling and grinding applications is provided with end fittings such as shown at *G* and *H*. The motor connection at *H* is designed to fit a standard make of universal motor. The shaft is 0.188 inch in diameter and is made to any desired over-all length.

An end fitting designed for carrying comparatively heavy torques at moderate rotating speeds is shown at *I*. These fittings are made to suit the spindles of the customer's machines. The casing is of the interlocked metallic type, and is regularly furnished with 1/2- or 3/8-inch shafts. The flanged end fittings of a flexible shaft combination that is used for driving locomotive speed indicators are shown at *J* and *K*.

It will be noted that special reinforcing springs are swaged fast to the casing ends of the flanged fittings. These springs, in combination with the rugged interlocked type of metallic casing shown at *D*, Fig. 3, make the assembly capable of withstanding the heavy and continuous vibration to which it is subjected. This particular combination is weatherproof and meets the conditions of outdoor service very satisfactorily.

* * *

Of the total American exports of machine tools, valued at nearly $30,000,000 in 1929, Great Britain took approximately 22 per cent, or over $6,000,000 worth. The total imports of machine tools into Great Britain were valued at nearly $9,000,000, while British machine tool exports were valued at over $10,000,000.

Special Tools and Devices for Railway Shops

Equipment Employed in Locomotive Repair Shops, Selected by Railway Shop Superintendents and Foremen as Good Examples of Labor-saving Devices

Lever Feed for Air Drill Used in Locomotive Shop

By E. A. LOTZ, Altoona, Pa.

The lever-operated feeding device shown in the accompanying illustration is applied to an air drill for drilling bolt holes in the front cab sheets, cab bottoms, and foot-boards of locomotives. It has been found a great improvement over the previous methods employed for this kind of work. The air motor is secured to the adjustable member *B* by the knurled sleeve *G*, which is threaded to fit the feed-screw of the air motor. Member *B* is a piece of heavy 1/2-inch pipe, 2 feet in length, which is screwed into one end of sleeve *G*. The member *B* is a sliding fit in a 3-foot length of heavy 1-inch pipe *A*. The collar *H* is welded to the pipe *A* and is fitted with a set-screw *K* which provides means for clamping member *B* to part *A*.

At the opposite end of part *A* is another piece of heavy 1/2-inch pipe *C* which is fitted with a conical center or point *F*. The trunnion bearings *I* and *J* for the levers *D* and *E* are 3/8-inch round iron bent to shape and welded to the pipes *A* and *C*. Each lever is constructed of two pieces of flat stock, 1 inch wide by 1/4 inch thick. This construction permits the levers to be assembled on the trunnion bearings *I* and *J*.

When the air motor is secured to sleeve *G*, the drill spindle is in line with the pipes *A*, *B*, and *C*. When the device is in use, the member *B* is adjusted to the proper position and clamped in place by set-screw *K*. In drilling a large number of holes where the space is limited, one workman holds the drill and controls the air valve to the motor while another man positions the center *F* against a suitable stop and actuates the feed-lever *D*.

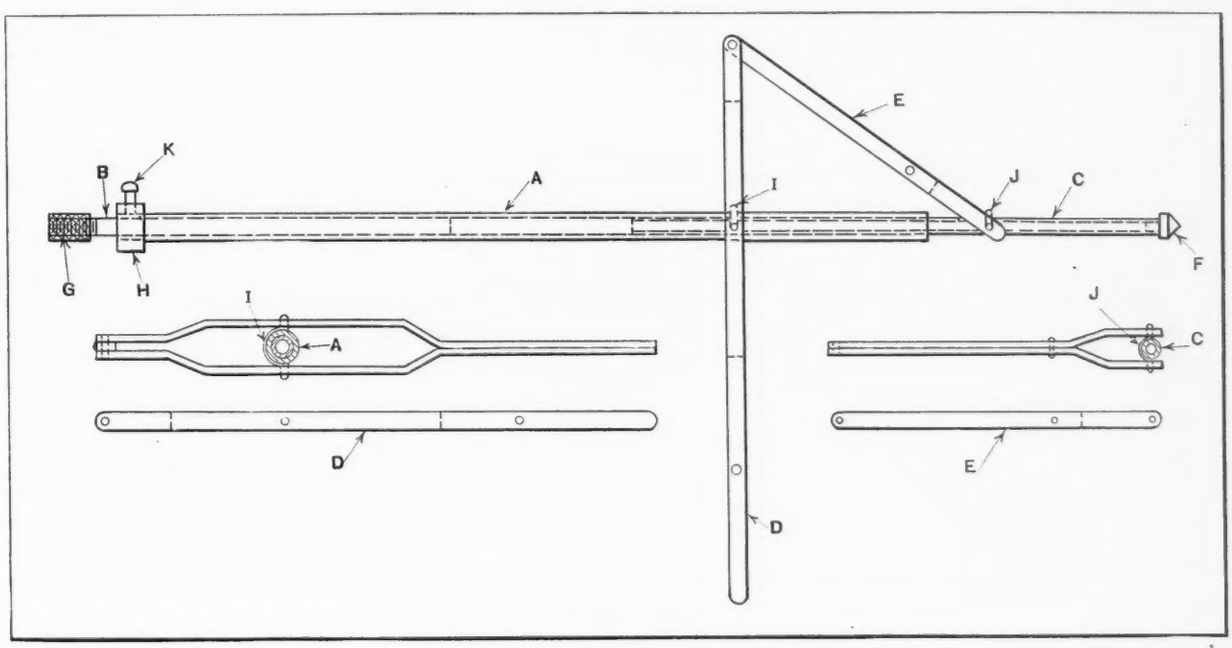
This arrangement has proved very efficient for drilling front cab sheets and the angle-irons to which they are secured when the angle-irons are in place on the firebox. For this work, the end *F* is placed in contact with the rear partition of the cab and the member *B* adjusted to bring the feeding handle *D* into a convenient operating position. When holes are being drilled through the cab bottom and foot-boards, the point *F* rests on the shop floor directly under the point to be drilled.

Portable Kerosene Cleaning Vat

By W. L. PARRISH, Tampa, Fla.

The portable cleaning vat shown in Fig. 1 is mounted on ball-bearing casters and can be easily taken to the job, thus eliminating the necessity for transporting parts to and from the usual types of stationary vats. This saves time on many jobs, and in some cases, does away with the need of individual vats for each job, thus not only preventing waste but also reducing the fire hazard.

The vat is constructed of 1/8-inch boiler plate with a frame of flat iron and angle-iron assembled



Lever-operated Feeding Device for Air Drill

by spot-welding. The corner posts are made of 1 3/4- by 1 3/4- by 1/4-inch angle-iron with pieces of 1 1/8-inch tubing *B*, Fig. 2, spot-welded in place to receive the shanks of the iron casters *C*. The boiler plate cover *D* is 36 1/2 inches long, 21 inches wide, 1/8 inch thick, and has iron handles *E* spot-welded to the upper side. The car jack handles *F* are also spot-welded to the vat.

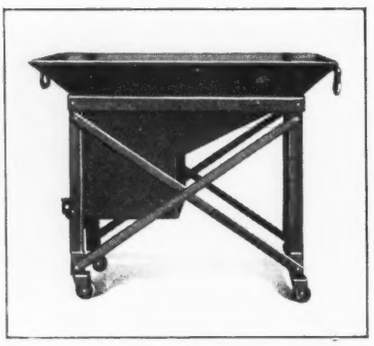


Fig. 1. Portable Kerosene Cleaning Vat for Railway Shop

One end of the vat serves as the oil container, while the other acts as a drain. As indicated by the principal dimensions given in Fig. 2, the vat has sufficient capacity to permit pieces of fairly large size to be completely submerged and left to soak, if necessary.

After the cleaning is completed, the work is placed on the wire netting *A* so that the oil will drip off and be carried back into the tank by the sloping side. If the work is too heavy to be held in one hand for cleaning with a stiff bristled bench brush, it can be supported on the netting.

About five or six gallons of kerosene are generally placed in the vat, although more or less may be used, as desired. The clear kerosene is drained from the vat each morning by opening valve *G*. After this has been done, valve *H* is opened and the residue, which is usually dirty liquid, hard grease, and dirt, is caught in a separate container. This residue is generally used in the roundhouse for starting the fires in the locomotive boxes. The clear liquid is poured back into the vat after the valves have been closed and the bottom of the vat has been cleaned. Enough clean liquid is added to meet requirements.

Keeping Die Castings Free from Impurities

In a paper read before the annual meeting of the Society of Automotive Engineers, held at Detroit, January 19 to 23, Robert M. Curts of the New Jersey Zinc Co., New York City, presented some valuable information on the many uses of zinc and zinc alloys in the automotive industry. Among other things, Mr. Curts referred to the serious effects of impurities in zinc die-castings. Too much emphasis cannot be placed on the importance of keeping the die-casting metal free from impurities, for the inherent quality of the finished product is, for the most part, governed by the impurities in the alloy from which it is made. Lead, cadmium, iron, and tin are the impurities most likely to be found in zinc-alloy die-castings.

If "Horse Head Special" or an equivalent high-grade zinc is used in the manufacture of the alloy from which the die-casting is made, and if proper care is exercised in the die-casting plant to prevent impurities entering the die-castings, no trouble should be experienced.

The effect of abnormal iron content is not so serious as abnormally high lead or cadmium content. High iron content is likely to affect the fluidity of the alloy when being die-cast and may result in surface defects on the castings.

Tin is a very undesirable impurity. It will cause failure due to excessive dimensional changes, and warping, swelling, and cracking, all accompanied by a marked loss in tensile and impact strengths. The tin content should be less than 0.005 per cent.

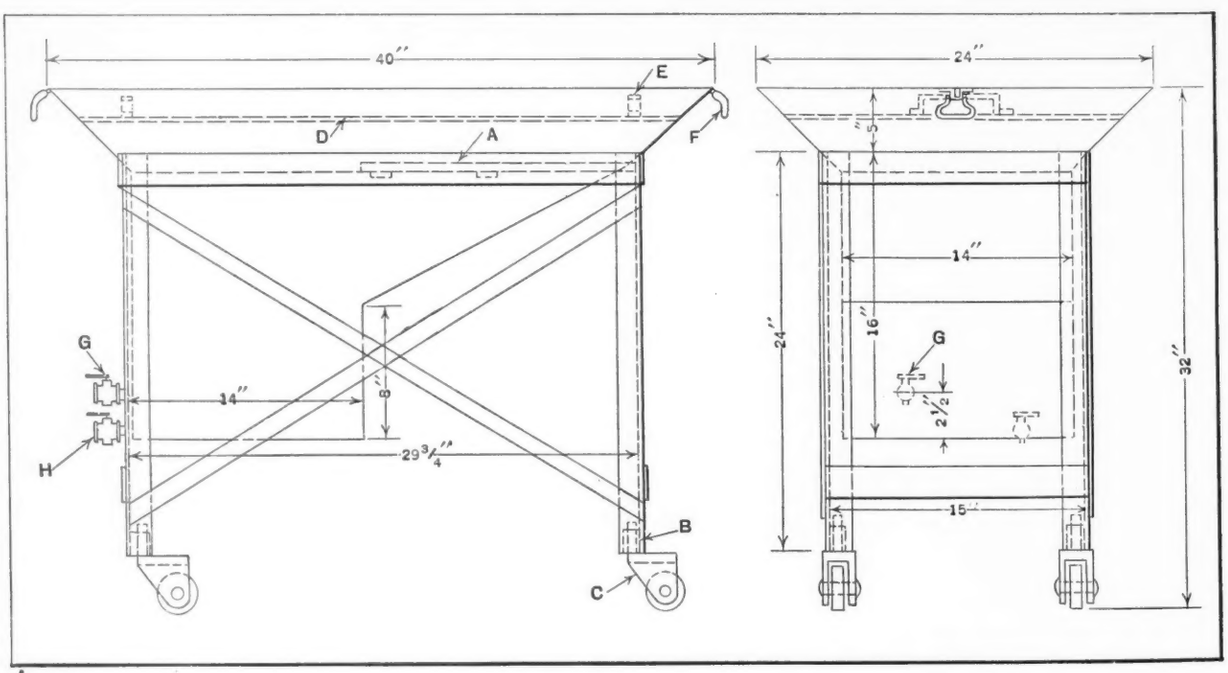


Fig. 2. Details of Vat Shown in Fig. 1

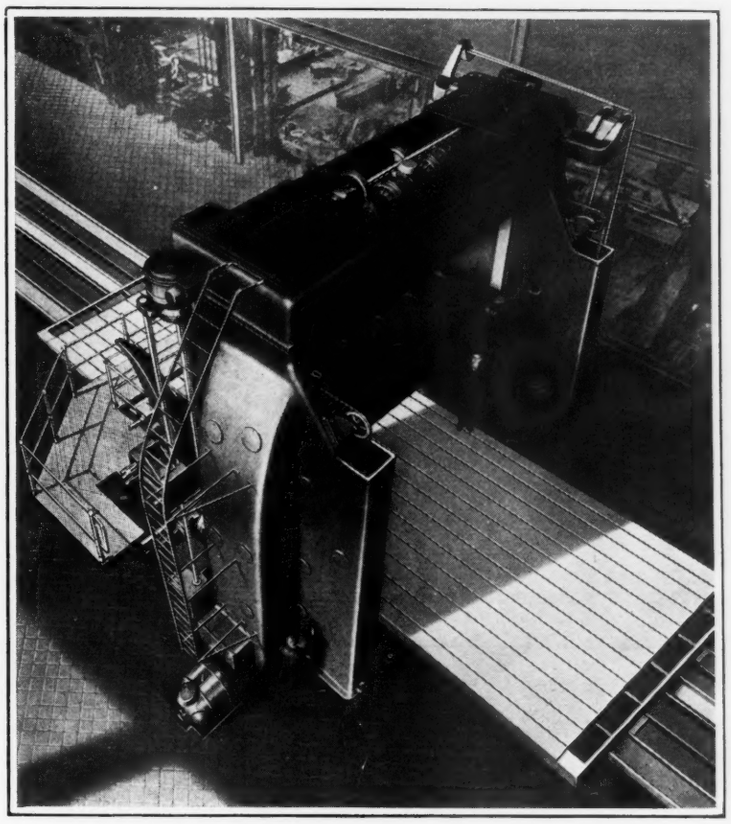
A Large European Planer

The accompanying illustration shows what might be termed an aerial view of what is claimed to be the largest planer now running in Europe. It was built by H. A. Waldrich of Siegen, Germany, and is installed at the Werkspoor-Works, Amsterdam, Holland, a plant engaged in building locomotives, Diesel engines, and sugar-mill machinery.

As the foundation under the plant consists of soft ground, it was necessary to drive a large number of piles, 35 feet in length, into the ground in order to provide a firm support for the planer.

The machine will plane work 15 feet wide and 40 feet long. The total floor space occupied is 30 by 86 feet. The table alone weighs 70 tons. The machine is driven by two direct-current reversing motors. The cutting and return speeds are independent of each other, and can be made to vary between 13 and 130 feet per minute. The operator can reverse the table by a push-button control. Strokes as short as 2 inches may be made by simply pressing the control button.

The table speeds are so arranged that an intermittent slow motion may be obtained while cutting, the table being speeded up between two castings when the tool is "cutting air." The feeds can be varied from 1/16 inch to 1 1/4 inches. The capacity of the driving motors is 120 horsepower.



One of the Largest Planers in Operation in Europe. Work 15 Feet Wide by 40 Feet Long can be Planed

* * *

While the railroads have lost a considerable amount of passenger traffic through the development of automobile and bus traffic, the volume of freight carried by the railroads has been increased materially by the growth of the automobile industry. During the first nine months of 1930, 22 per cent of the carload freight classified as "Manufactures and Miscellaneous" consisted of automobiles, automobile parts, and gasoline.

A New Semi-stainless Steel

Stainless steels, as is well known, depend on the presence of chromium and sometimes nickel for their non-corrosive properties. Unfortunately, the content of these alloying elements must be quite high, which makes the cost of stainless steel too great for many purposes. Attempts have been made to discover a steel which, while not entirely stainless or rustless, would be practically impervious to the action of water and acids over long periods, and which at the same time could be produced at a sufficiently low price to find wide application.

According to *Engineering*, the Vereinigte Stahlwerke A. G., Düsseldorf, Germany, has developed a steel in which copper is an alloying element and which meets the requirements for a low-priced semi-stainless steel. The new product is known by the trade name "Patina." It appears to be highly resistant to corrosive influences; at the same time, its price is said to be not more than $2.50 per ton greater than ordinary steel. This new steel has already found wide application in Germany. It is also claimed that a coat of paint applied to Patina steel will last nearly twice as long as one applied to ordinary steel. The qualities of this steel, coupled with its low price, should make it of considerable value in cases where a corrosion-resisting steel is required but where the cost of the higher grades of stainless steel may not justify their use.

* * *

It does not seem reasonable, but it is nevertheless a fact, that there are more passenger automobiles than telephones in the United States. There are over 23,000,000 passenger cars and only 20,000,000 telephones. Someone has figured out that for every time a telephone bell rings, an automobile has traveled six miles.

Design of Static Balancing Machine

By Imparting an Oscillating Circular Motion to the Work-holder, the Heaviest Point of the Work is Easily Located

By GEORGE L. PYRITZ

OSCILLATING circular motion is imparted to the work-holding adapter of the static balancing machine here illustrated to cause the heaviest point of the work to fall to the lowest position. Correction is then made by means of a drill in spindle *A*, Fig. 1, after which the work is given a circular movement by the operator to change its position and permit the heaviest point to be located again in the same manner as before. This process is repeated until the piece is in balance.

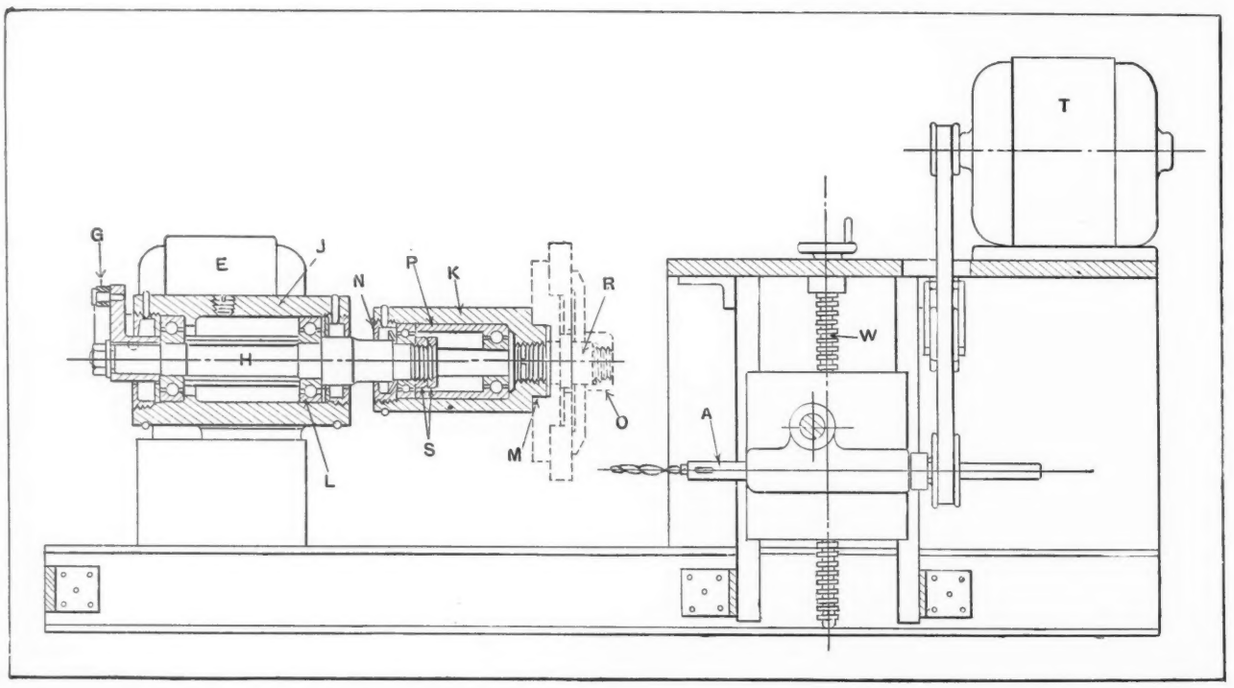


Fig. 1. Static Balancing Machine in which an Oscillating Circular Motion is Imparted to the Work-holding Adapter

The machine was designed to balance disks efficiently on a production basis, whether the quantities of work are large or small. An experienced operator can balance pieces rapidly and with great accuracy. The machine has been in service for about two years and has paid for itself many times over.

The base of this equipment is constructed of two 3-inch structural-steel channels on which are bolted two 3/8-inch flat steel plates forged to the shapes shown at *B* and *C*, Fig. 3. The oscillating movement mentioned is imparted to the work-holding adapter through eccentric *D* which is mounted on the shaft of a 1/4-horsepower motor *E* and driven by that motor. From Fig. 2 it will be seen that the eccentric unit is of ball bearing construction. The axis of the eccentric unit is 1/32 inch off the center of the motor shaft.

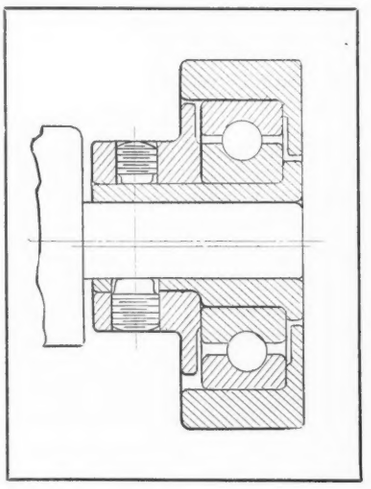


Fig. 2. Section through the Eccentric Unit (X-X, Fig. 3)

Connecting-rod *F*, Fig. 3, is screwed into the bearing housing of the eccentric unit and secured by a lock-nut, this construction preventing the housing from turning with the eccentric. The other end of the connecting-rod is screwed into a bushing which is a slip fit over a shoulder pin pressed into crank *G*, Fig. 1. Thus the oscillating movement imparted to the connecting-rod by the eccentric is transmitted to crank *G*. This crank is keyed to spindle *H* which passes through the stationary bearing housing *J* and into the rotating bearing housing *K*. Ball bearings are mounted in both housings in the usual manner, bearing *L* being a floating fit in its housing.

The rotating bearing housing *K* carries an adapter on which the work that is to be balanced is

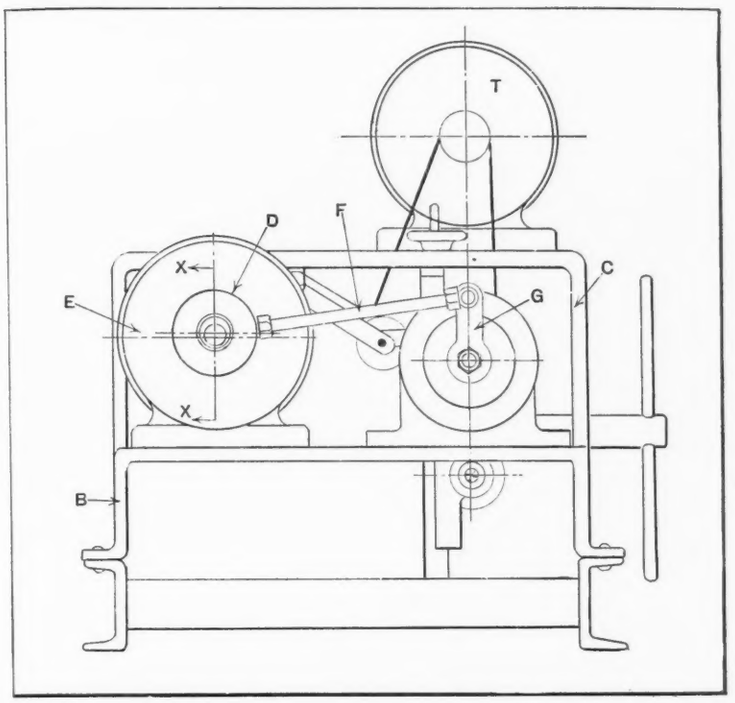


Fig. 3. End View of the Static Balancing Machine Shown in Fig. 1

mounted. Stud *R* of this adapter is screwed into a tapped hole in the housing. The adapter proper is a close fit on shoulder *M* so that it is held concentric with the housing. The adapter must be made to fit the piece to be balanced closely, the latter being held on the adapter by means of a nut *O*, which is counterbored to fit closely on stud *R*.

The ball bearings are held in the housing *K* by means of a retainer *N* and a spacer *P*. The nuts *S* hold the inner race of one bearing in the proper location on spindle *H*. The bearings are assembled without oil, and housing *K* is free to rotate without drag. This housing, the adapter, clamping plate, and nut *O* were balanced both individually and as a unit.

The drill-spindle slide is raised or lowered by turning screw *W*. Thus the piece can be drilled at any radius from its center. The belt through which power is delivered to the drill spindle from motor *T* runs over two idler pulleys which compensate for changing center distances between the motor pulley and the drill-spindle pulley as a result of adjusting the drilling position.

* * *

Two Thousand Employes Aided

Under the General Electric Co.'s Unemployment Insurance Plan, up to the first of March, $69,987 has been paid to 682 employes who were laid off because of lack of work, and $38,610 to 1509 employes on part time employment, making a total of $108,597 paid from the unemployment fund to 2191 employes.

Drill and Counterbore for Soft Rubber

By H. C. MEYERS

Occasionally machinists are confronted with the job of drilling and counterboring holes in soft rubber. Easy as this may seem, it is very difficult to produce a good looking job with a smooth clean cut surface unless the proper tools are used. The drilling can be done very satisfactorily with a hollow drill ground to a sharp edge, as shown at *A* in Fig. 1. An elongated opening in the side of the drill is provided for extracting the slug. It should be kept in mind that the wall of the drill must be as thin as possible to insure accuracy in drilling the hole.

The counterbore, however, is more difficult to make, due to the fact that the cutting edge must have a slicing action. A tool that will counterbore soft rubber to a remarkable degree of accuracy and will also produce a fine finish is shown at *B*. This tool can be made in the following manner at a very low cost:

A piece of steel of suitable size is turned down at both ends to form the shank and pilot, leaving a disk about 1/32 inch thick to be formed into a cutter. The outside diameter of the disk is next filed to a spiral contour, as shown at *C*. The inside of the spiral ends at a depth about 1/16 inch below the diameter of the pilot. The spiral disk is then given a slight twist so that it will have a lead along the center line of the counterbore. The disk is now ground to a sharp edge, the bevel of the edge being

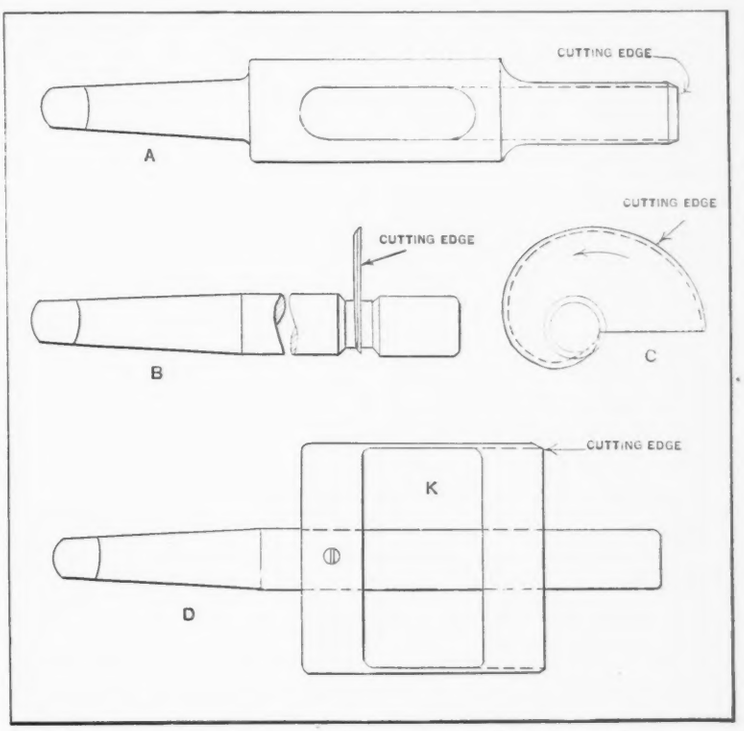


Fig. 1. Details of Combination Drill and Counterbore

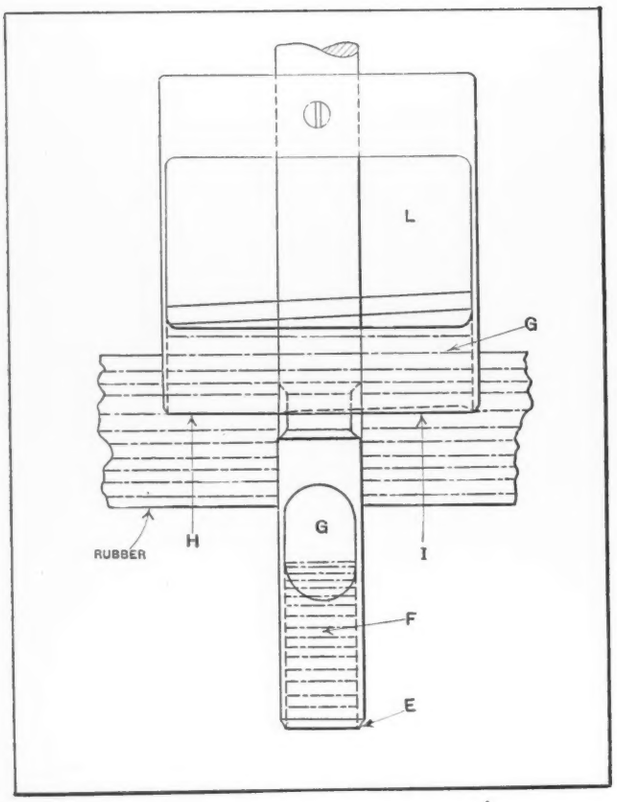


Fig. 2. Tool for Drilling and Counterboring Soft Rubber in One Operation

on the back side as shown. This disk is shown to a larger scale at *A*, Fig. 3. At *D*, Fig. 1, is shown the tool used for finishing the diameter of the counterbored hole. Opening *K* provides a space for injecting the cutting lubricant.

In Fig. 2 is shown a combination of the tools already described that will drill and counterbore the rubber in one operation. The cutting edge of the drill is at *E*, while *F* represents the slug removed from the work. Opening *G* is provided to facilitate removing the slug from the drill. The circular edge *H* represents the cutting edge of the tool used for finishing the large diameter, and *I* is the cutting edge of the spiral shaped disk that slices the soft rubber from the side of the hole being counterbored. These edges are shown to a larger scale at *B* in Fig. 3. The rubber comes out of the counterbored hole in the shape of a long spiral chip, which is removed through the opening shown at *L* in Fig. 2.

This tool produces a very smooth and accurate finish on the side walls, as well as on the bottom. Plain water should be used as a cutting lubricant. Oil should not be used under any consideration, as it causes deterioration of the rubber.

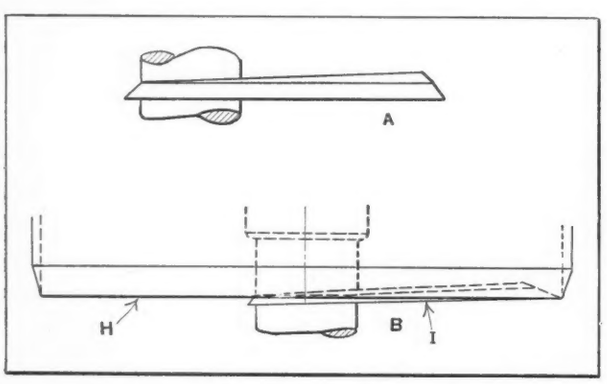


Fig. 3. Enlarged View of Counterbore Cutting Edges

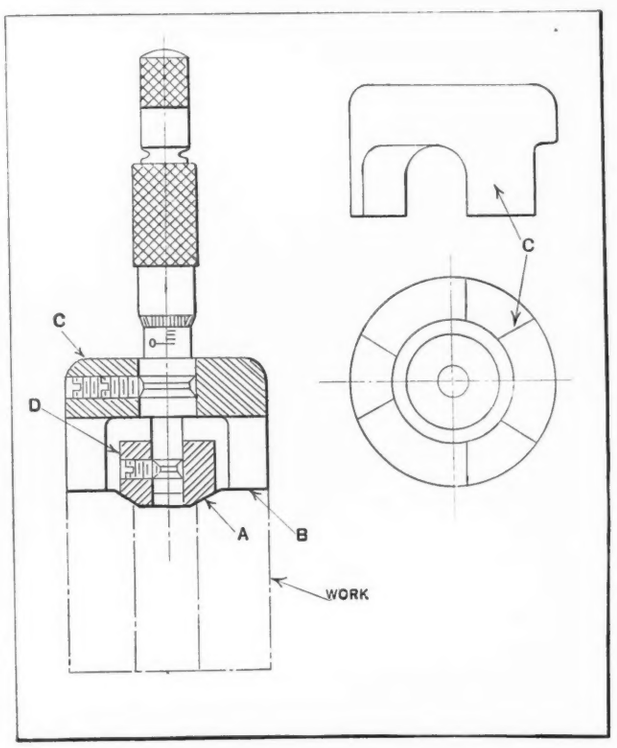
* * *

Inspection Gage with Micrometer Head

By W. E. GUNNERSON, Rockford, Ill.

The gage shown in the accompanying illustration was designed to determine the position of the tapered surface *A* in relation to surface *B*. A standard micrometer head was purchased, and the parts *C* and *D* were made and fitted to the micrometer.

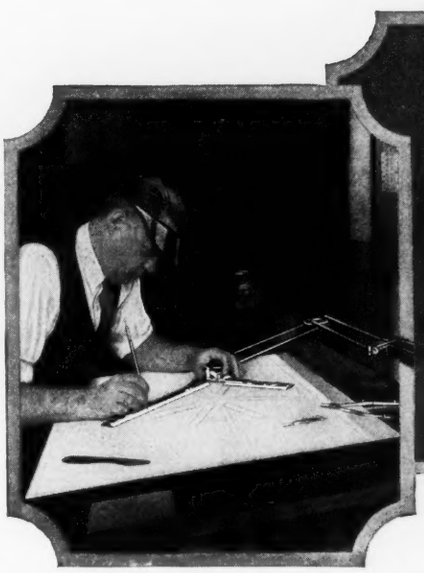
Two small screws with their ends fitting into grooves ground in the micrometer head in the positions shown serve to hold the parts *A* and *C* in place. Shellac was applied to the screws when they were assembled in order to keep them in place. No accurate settings were necessary in assembling the gage, a master part being measured and the micrometer reading recorded on the production blueprint after the gage had been assembled. In this case, the work was held within ± 0.0005 inch.



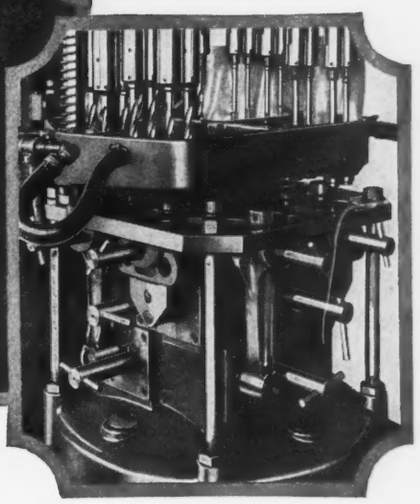
Gage for Determining Position of Tapered Surface in Relation to Another Surface

* * *

A provision for insuring the infallibility of airway beacons used by the Department of Commerce is an arrangement whereby a burned out bulb is automatically replaced by another bulb.



Design of Tools and Fixtures

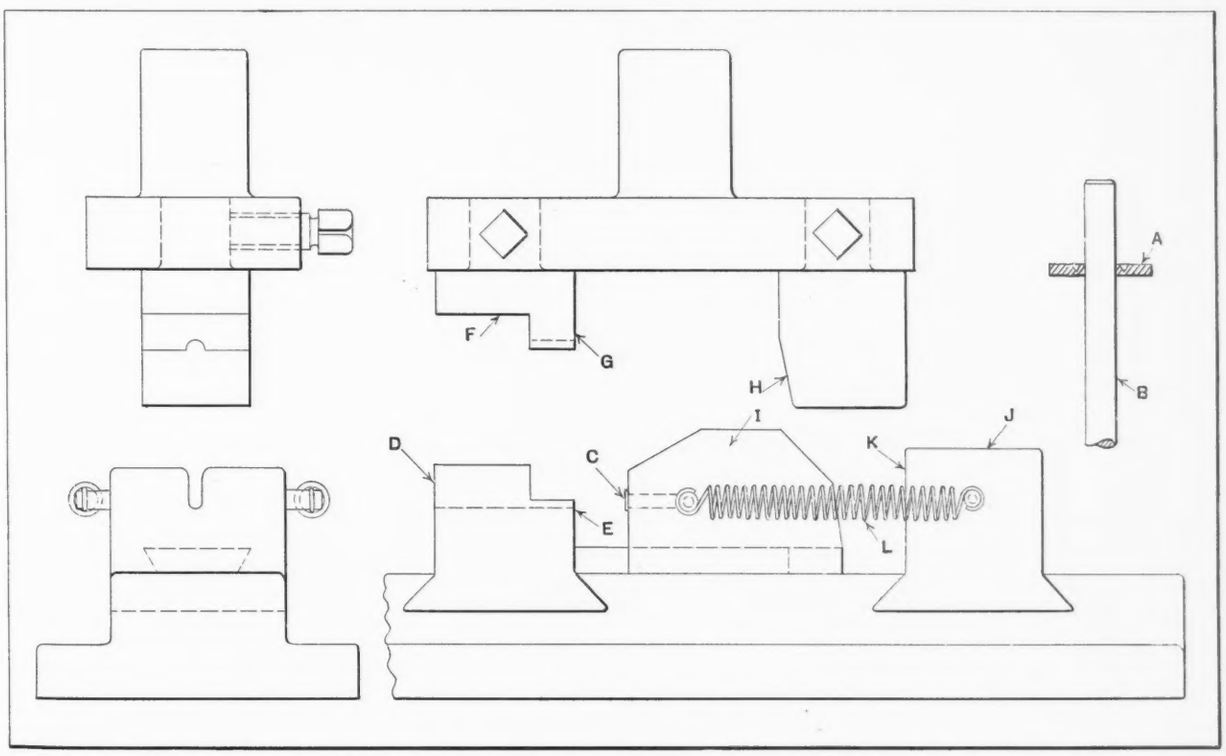


Swaging Die for Assembling Collar on Shaft

By F. C. MASON, New Albany, Ind.

The die shown in the illustration was designed for swaging the collar *A* on the shaft *B* so that the collar will be held securely in place. The impression left in the collar by the swaging punch *C* is shown in the cross-section of the collar at *A*. The first die used for this job was of the usual split type with the swaging punch located in a vertical position. Such a die is slow in operation, as it is necessary to bring the shaft up through the bolster. The production of this die was not over 120 pieces per hour, as compared with an output of at least 800 pieces per hour with the die illustrated.

The operation of the die is as follows: The shaft *B*, with the collar *A* in place, is simply placed in the slot in anvil *D*, the collar resting against the hardened surface *E*. On the downward stroke of the press ram the tool-steel member *F*, which is also hardened on the surface *G*, descends and clamps the shaft *B* securely in place. The hardened tool-steel cam-punch *H* then comes in contact with the block *I*, moving it to the left and actuating the swaging die *C*. The cam-punch *H* is backed up by block *J*, which is hardened on the face *K*. The springs *L* withdraw block *I* on the upward movement of the ram.



Die Used in Assembling Collar on Shaft by Swaging

Use of Indexing Head for Hobbing Worm-Gears

By KURT F. ZIEHM, Chicago, Ill.

The usual procedure in cutting worm-gear teeth by gashing and hobbing was found to be impossible in milling the worm-wheel shown in Fig. 2. The hob dragged and dug into the sides of the teeth, leaving ridges which, of course, would not give the long-wearing surfaces and quiet operation desired. The worm-wheels have sixteen teeth, are 24 pitch, and have a pitch diameter of 0.6666 inch.

In operation, this worm-wheel engages a worm having a quadruple thread, so that for each revolution of the worm the worm-wheel revolves one-fourth revolution. The quantity of these gears to be made did not warrant the purchasing or making of special equipment; for that reason, the method described in the following was adopted.

A B&S indexing head, as shown in Fig. 1, was used for obtaining a positive rotary drive for the worm-gear. However, to adapt this head to the job, it was necessary to remove the table from the machine in order to take the feed-nut off the feed-screw. The necessity of removing the nut is obvious, as the table must be locked stationary while the feed-screw is revolving.

The next step was to determine accurately how many turns the table feed-screw made to four revolutions of the spindle. Four turns of the spindle were required, because it takes four revolutions of the hob to cut around the gear.

The turns of the feed-screw were measured by means of a cardboard disk fastened back of the hub of the screw handle. A piece of steel clamped to the table served as a straightedge for drawing a line on the disk to indicate the starting point. The spindle was then revolved four turns, the number of turns of the disk noted, and another line drawn to indicate the finishing point. Of course, it is understood that all lost motion was taken up at the start.

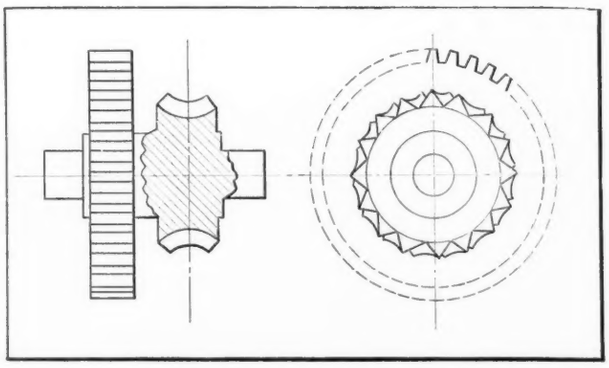


Fig. 2. Small Worm-gear Hobbed with Set-up Shown in Fig. 1

In this way, it was found that the screw made 1 207/360 or 1.575 turns. It was now only a matter of selecting the proper gears for the screw and the dividing head spindle. This was done by proportion—$1 : 1.575 = 40 : X$; hence $X = 63$. Therefore, with a 40-tooth gear on the screw and a 63-tooth gear on the dividing head spindle, the required ratio of 4 to 1 beween the cutter-spindle and the worm-gear was secured.

A drive pin for the worm-gear was arranged in such a way that it could be disengaged from the gear when the cutter had reached a depth of 1/16 inch, permitting the gear to revolve independently.

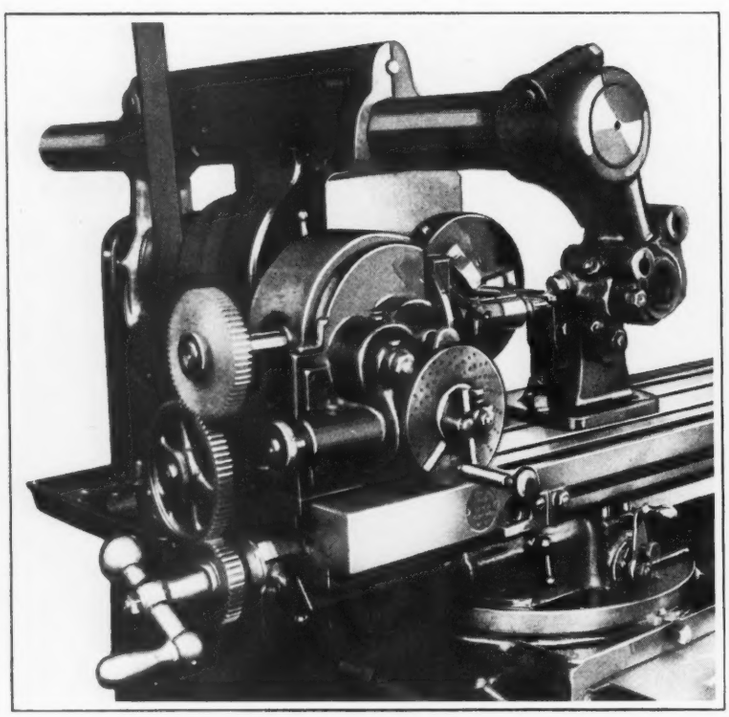


Fig. 1. Set-up Showing how an Indexing Head is Used to Impart Rotary Motion to a Worm-gear being Hobbed

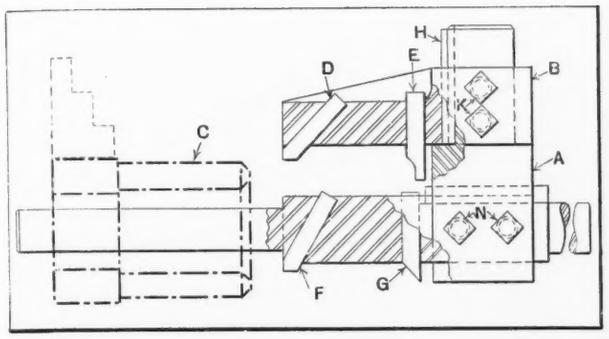
Adjustable Boring, Facing and Turning Tool

By W. N. DELENK, Cleveland, Ohio

In the illustration is shown a combination boring and turning tool for use in a turret lathe. This tool has provision for both radial and longitudinal adjustment. The cutters for boring are secured in a bar that fits the station hole in the turret. On this bar is mounted a bracket *A* on which slides the arm *B* that carries the turning and facing tools.

Arm *B* is prevented from rotating on bracket *A* by the feather key *H*. The arm can be adjusted radially by loosening the two set-screws *K*. To prevent rotary movement, bracket *A* is keyed to the bar. For adjusting the turning and facing tools longitudinally, the bracket may be slid along the bar and secured by means of the set-screws *N*.

Referring to the work *C*, which is shown in position in the chuck, the tool bit *D* is set to turn the outside diameter, while tool bit *E* faces the end and forms the bevel. The boring is done by means of the tool *F*,



Turret Lathe Tool in which Cutters may be Adjusted Radially or Longitudinally

after which the tool *G* bevels the end of the bore. A pilot, integral with the bar, is provided in this case to give the required rigidity to the tool.

With slight modifications, such as changing the position or the number of the tool bit slots, this tool can be adapted for many similar jobs.

Die for Correcting Error in Gears

By I. C. GELLMAN, Gellman Mfg. Co., Rock Island, Ill.

After cutting the teeth in several thousand small spur pinions, it was found that the pinions would roll freely in one direction when in mesh with a rack, but that they had a tendency to become locked when rolled in the opposite direction. A slight error in centering the gear tooth cutter appeared to have been the cause of this trouble. The pinions had ten teeth of 1/4 inch circular pitch, and were required to roll freely in both directions when in mesh with the rack. Thus it was necessary either to scrap the whole lot of pinions and cut new ones or to find some means of correcting the teeth. The latter course was decided upon, and carried out successfully with an actual saving of more than $1600.

The method of salvaging the pinions consisted of heating them to a cherry red and pushing them through an accurately formed die in a press. With this equipment, 850 gears were accurately sized per hour by two operators, one attending to the heating, while the other operated the press. The sizing die consisted of a ring 5 inches in diameter and 3 inches thick, having ten radial slots 5/16 inch wide and 1 1/2 inches deep milled on one face, and ten tooth-sizing pieces inserted in the radial slots and held in place by bolts.

The tooth-forming or sizing pieces were made of 5/16-inch by 2-inch flat stock milled to the correct contour at their ends with a fly cutter. This fly cutter was made with the original cutter employed for cutting the gears. The tooth-sizing pieces were hardened properly and were backed off on the top side to permit the pieces to be started easily and forced through the assembled die. The face width of the pinion was 5/16 inch and the face width of the sizing die formed by the inserted pieces was 2 inches, less 3/8 inch that was backed off so as to start the gear easily.

Indexing Indicator for Spacing Keyways

By JOSEPH C. COYLE, Englewood, Colo.

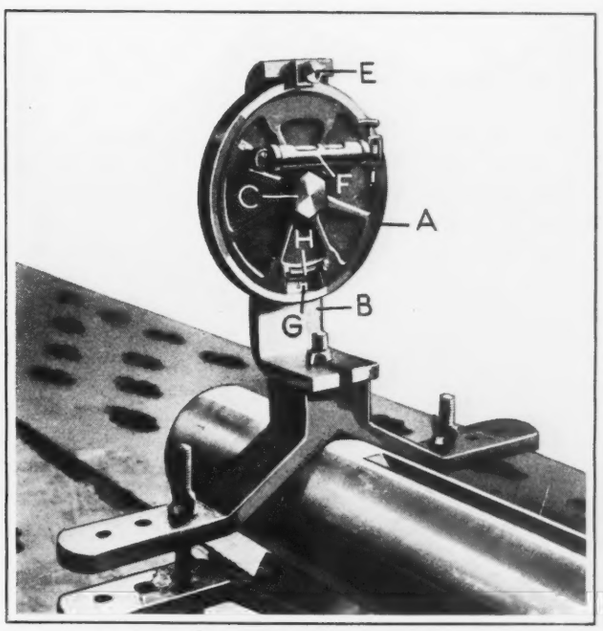
The instrument shown in the accompanying illustration provides a convenient means of indexing a lineshaft for cutting keyways that are required to be positioned accurately with respect to their angular spacing. The illustration shows the instrument clamped to a shaft which is mounted on a milling machine table.

The essential parts are a stationary disk with angular graduations near its outer edge and a revolvable disk on which a spirit level is mounted. The stationary disk is held firmly to the strap *B* by a screw *C*, which passes through the revolvable disk *A*. Disk *A* is 5 1/4 inches in diameter by 1/2 inch thick, and can be revolved on screw *C* only when the small brass set-screw *E* is loosened.

On the face of disk *A* is mounted the spirit level *F*, and near one edge is an opening *G* having a brass indicator strip *H*. There is a zero or center line on strip *H* which is used in setting disk *A* to any desired angle on the scale of the stationary disk, which is viewed through the opening *G*.

In use, the instrument is attached to the shaft by a pair of V-clamps, as shown in the illustration, after the first keyway has been cut. The V-clamps are made of steel, 2 inches wide by 1/2 inch thick. The upper clamp has a block of steel welded to its upper surface. The bracket *B* is secured to this block with a thumb-nut as shown.

After the instrument is in place on the shaft, it is adjusted until the zero point on the scale and the center line on strip *H* are in line and the bubble in the level is centered. Set-screw *E* is then loosened and disk *A* turned until the pointer or line on strip *H* is opposite the desired angle on the scale viewed through the opening *G*. Set-screw *E* is



Instrument for Indexing Shaft to Obtain Desired Angular Spacing of Keyways

next tightened and the shaft turned around until the bubble in the level is in the central position. The shaft will now be in the correct position for cutting the second keyway. Thus, the shaft can be indexed for cutting successive keyways with any desired angular spacing such as 40, 60, or 90 degrees. The instrument described was developed by Charles R. Maul at the General Iron Works, Englewood, Colo.

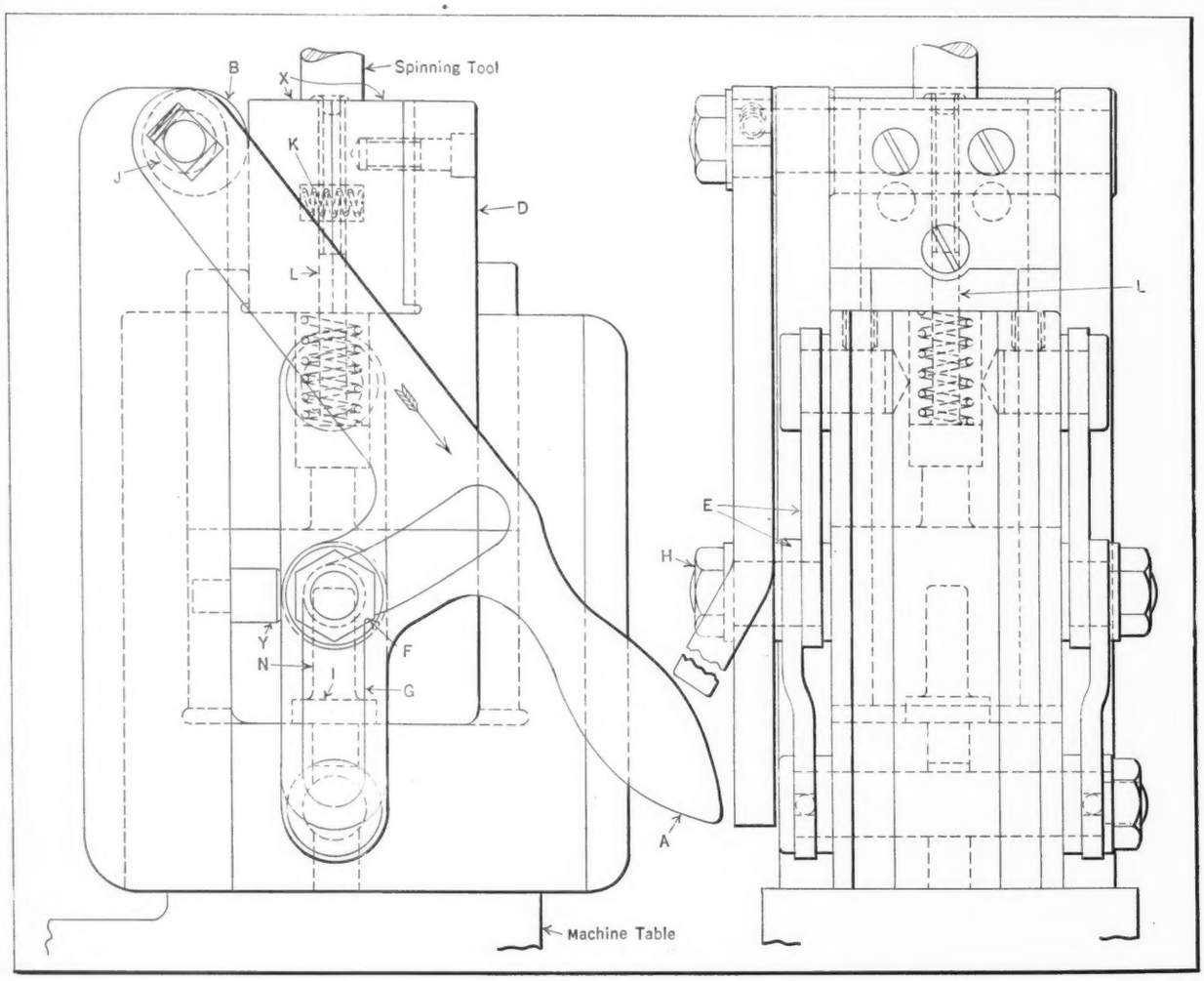
Toggle Fixture for Spinning the Ends of Tubes

By THOMAS F. MORRISSEY, Buffalo, N. Y.

In the illustration is shown a fixture used on a machine of the riveting type for holding a tube while its end is being spun over. This fixture is operated by a single lever which raises the tube to the spinning position, where it is held securely by means of the jaws *X* operated by a cam on the same lever. This vertical movement is necessary in order to provide sufficient room between the fixture and the spinning tool for the tube to be inserted in the jaws when in their lower position.

The jaws are of the split type, and when not in a clamping position are held open by the coil spring *K*. They are mounted in the member *D* which slides vertically in the fixture base secured to the machine table. Vertical movement is imparted to slide *D* by means of the toggle levers *E* which are actuated by the hand-lever *A*. The upper end of lever *A* oscillates about the center of the camshaft *J*. One end of this shaft is square and is a sliding fit in a rectangular hole in the end of the hand-lever. Normally, the square part of the shaft is in contact with the lower part of the slot in the lever and is held in this position by means of a spring. The purpose of this construction will be explained later.

In operation, the lever *A* is swung in a counterclockwise direction to its furthest position. This movement carries the center stud *H* of the toggle levers to the right and allows the slide *D* to descend until it comes in contact with the shoulder *I* on the stud *N*. In this position, the jaws *X* are open, allowing a tube to be inserted. The lower end of the tube rests on the end of spring-actuated plunger *L*, which serves as a stop for locating the tube and, also, as an ejector for forcing the tube out of the jaws after the operation. The lever is now swung downward, causing the stud *H* to move to the left

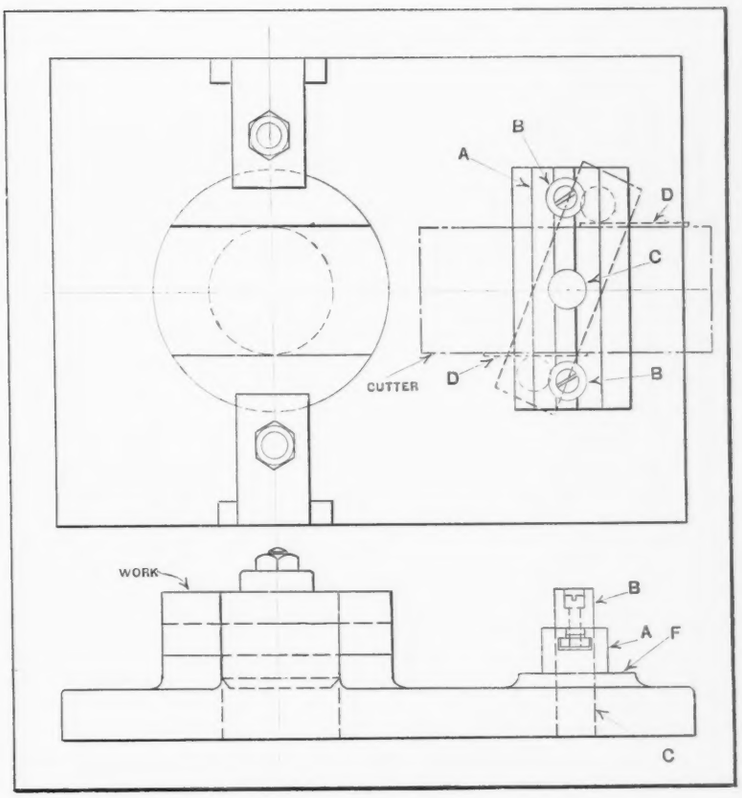


Fixture Operated by a Hand-lever which Elevates a Tube into Position for Spinning

until the toggle levers are in line and against the stop *Y*.

In the position shown, the cam *B* is in contact with the jaw at the left, and continued downward movement of lever *A* will clamp both jaws securely on the work. To permit this motion of the lever, the slot *G* was continued in a path concentric with the center of the camshaft. As the corner *F* of the slot comes in contact with stud *H*, lever *A* is forced downward in the direction of the arrow against the action of the camshaft spring, causing the rectangular hole in the lever to slide on the square end of the camshaft.

This arrangement compensates for any variation in the outside diameter of the tube. Without this compensation, the clamping position of the hand-lever would also vary and prevent the alignment of stud *H* with the curved slot, causing binding between these members. In the clamped position, the tube is ready to be spun over, and all that is necessary is to feed the spinning tool downward against the tube by means of the equipment provided on the machine. After the tube has been spun over, lever *A* is swung upward to unclamp the jaws.



Centralizing Cutter-gage Adjustable for Different Cutter Widths

Adjustable Gage for Setting Milling Cutter

By D. A. BAKER, Long Island City, N. Y.

In setting a cutter central with a milling machine fixture, say for slotting a part to a given depth and width, three gaging points are usually required—one to set the cutter to the correct depth, and the others to locate it laterally, a feeler strip being used in conjunction with the gaging points.

The gage is shown in the illustration mounted on a pad *F* cast on the fixture base. A hole *C* is bored and reamed through this pad on the exact center line of the part to be milled. The gage is so constructed that it can be adjusted for various cutter widths, and it is also adapted for use between a pair of cutters. One gage can be used for setting cutters on a number of fixtures.

The hardened and ground block *A* has a T-slot cut along its entire length. Two round buttons *B* are shouldered at the bottom and are a sliding fit in the T-slot, so that they can be adjusted along the block and securely fastened with the screws and nuts provided. In the center of the block is a ground hole *C*. By inserting a plug in this hole and through the fixture and using a standard gage-block against the sides of the plug, the buttons *B* can be set equidistant from the hole *C*.

The cutter is set for depth of cut from the top of the block *A*, a feeler being used between the block and the cutter. To centralize the cutter, two thin parallels *D* of equal thickness are placed one on each side of the cutter and the block *A* is swung to the position indicated by the dotted lines. The table is then adjusted laterally until the two buttons *B* bear with equal pressure against each of the parallels. When this occurs, the cutter will be central.

* * *

Safety Precautions in Gas Cutting

In a recent issue of *The Locomotive*, the possibility of accident due to the use of acetylene cutting torches in boilers or other closed vessels unless proper precautions are taken is pointed out. The following incident is quoted from the *Zeitschrift für Gewerbehygiene*:

Two men were inside a boiler doing some cutting by means of gas torches. They had finished a considerable portion of their work when the man who was attending to the gas supply on the outside heard calls for help. Both welders emerged from the boiler with their clothes blazing so fiercely that they sustained very severe burns.

The cause of the accident was rather unusual, although quite understandable. The torches were in working order and were being correctly handled. However, as the cutting work required an excess of oxygen, this gas quickly filled the vessel and permeated the men's clothing. When a spark accidentally struck the clothing of one of the workmen, the oxygen-impregnated cotton material burst into flames. This incident seems to point to the necessity of thoroughly ventilating boilers and tanks when gas cutting or welding is going on inside.

Pressing Bakelite Disks at High Speed

Equipment that Forms 400 Disks per Minute and Transfers Them by Suction to the Conveyor Belt of a Curing Oven

SMALL disks, 1/4 inch in diameter by 0.010 inch thick, are produced from Bakelite powder at the rate of 400 per minute in the machine illustrated in Fig. 1. This machine is installed in the plant of the Allen-Bradley Co., Milwaukee, Wis. The disks are baked after they leave the pressing machine, and because of the high rate at which they are produced, it was found desirable to provide a means of transferring them automatically from the pressing machine to the conveyor belt of the baking oven. Difficulty was experienced in developing apparatus for this purpose on account of the fragility of the disks. The problem was solved by devising the equipment illustrated in Fig. 2, which handles the disks by suction.

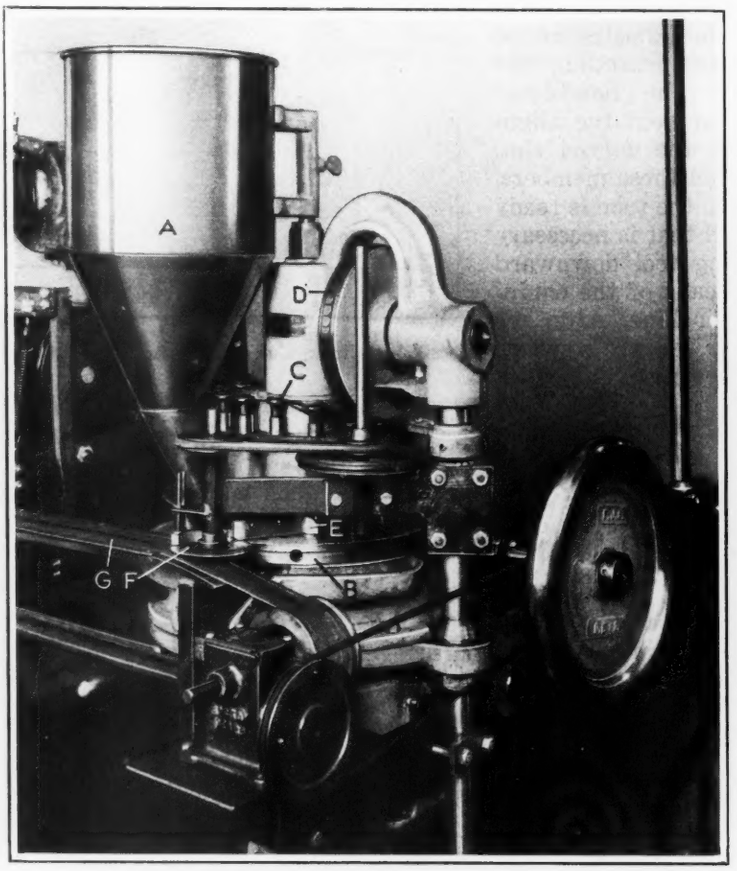


Fig. 1. Machine that Automatically Compresses Bakelite Powder into Disks 0.010 Inch Thick at the Rate of 400 Per Minute

Sixteen Pairs of Plungers Form the Disks

The machine used for pressing the disks is a standard product of the F. J. Stokes Machine Co., Philadelphia, Pa., and is of a type extensively used by the pharmaceutical trade. The Bakelite powder is loaded into the hopper *A*, Fig. 1, and is fed into small cavities in the top of plate *B*, which are of the same diameter as the disks to be produced. Plungers at the bottom of these cavities are lowered slightly more than the disk thickness at the time of loading, so as to insure a sufficient amount of powder being fed into the cavities. Then, as each cavity leaves the loading point, the plunger is raised, through cam action, and the excess powder is wiped off the top by means of a metal blade. Looking down from above, table *B* revolves clockwise.

Rotating in synchronism with table *B* there is a unit containing sixteen overhead plungers *C*, one of which is in accurate alignment with each table cavity. At the time that the cavities are loaded with powder, plungers *C* are in the raised position, as shown next to hopper *A*, but after the excess powder has been wiped away, the plungers are lowered gradually. They finally pass under the revolving wheel *D*, and are forced under heavy pressure into the cavities and against the lower plungers, thus compressing the powder into disks.

As plungers *C* leave wheel *D*, they rise once more, and the bottom plungers are also raised to eject the disks from the cavities. The disks then meet blade *E*, which rests on the table and deflects them on a slow-running wheel *F*. This wheel carries the disks to the left above the fine-mesh conveyor belt *G*. They slide from the wheel onto the conveyor without breaking.

From Fig. 2 it will be observed that the narrow conveyor belt *G* extends over a wide belt *H* which conveys the disks through the baking oven. Transfer of the disks from belt *G* to belt *H* is effected by means of tube *J*. This tube has a row of minute holes extending along the bottom in line with the center of belt *G*. Overhead the tube is connected to blower *L*, which creates suction through the flexible hose and the tube each time that a valve is opened by the operation of rod *M*.

A mechanism on each side of conveyor belt *H* automatically raises tube *J* from the position shown, advances the tube toward the oven, and then lowers it close to belt *H*. The tube remains there momentarily, and is then lifted again and lowered over belt *G*.

When the tube is over belt *G*, rod *M* is operated to open the air valve, and the suction created in the tube immediately draws the disks up against its under side. The disks are held securely to the tube until the latter has been lowered over belt *H*, at which time rod *M* is again operated to close the air valve. This allows the disks to fall on belt *H* face downward without breaking.

Tube *J* does not actually touch either belt, and there is sufficient clearance between the belts and the tube so that the latter does not touch the disks before or after suction is produced. If the tube were lowered into contact with the disks, they would be shattered.

Milwaukee Apprentice Awards

Approximately 475 apprentices and officials of machinery building plants in Milwaukee attended the annual dinner recently given by the Milwaukee branch of the National Metal Trades Association for the apprentices in the city's machine shops who are in the last year of their course. The dinner was given as an official recognition of the achievement of those apprentices who will graduate this year, and also in honor of those who have been successful in the trade contests for apprentices conducted by the Metal Trades Association during the past year. Harold S. Falk, vice-president and works manager of the Falk Corporation and chairman of the National Metal Trades Apprenticeship Committee, was chairman of the dinner and meeting. The winner of the first prize in the machinist contest was Frank Bozdeck of the Falk Corporation; the second prize was won by Victor Bartlett of the Oilgear Co., and the third prize by Alfred Masch of the Cutler-Hammer Mfg. Co.

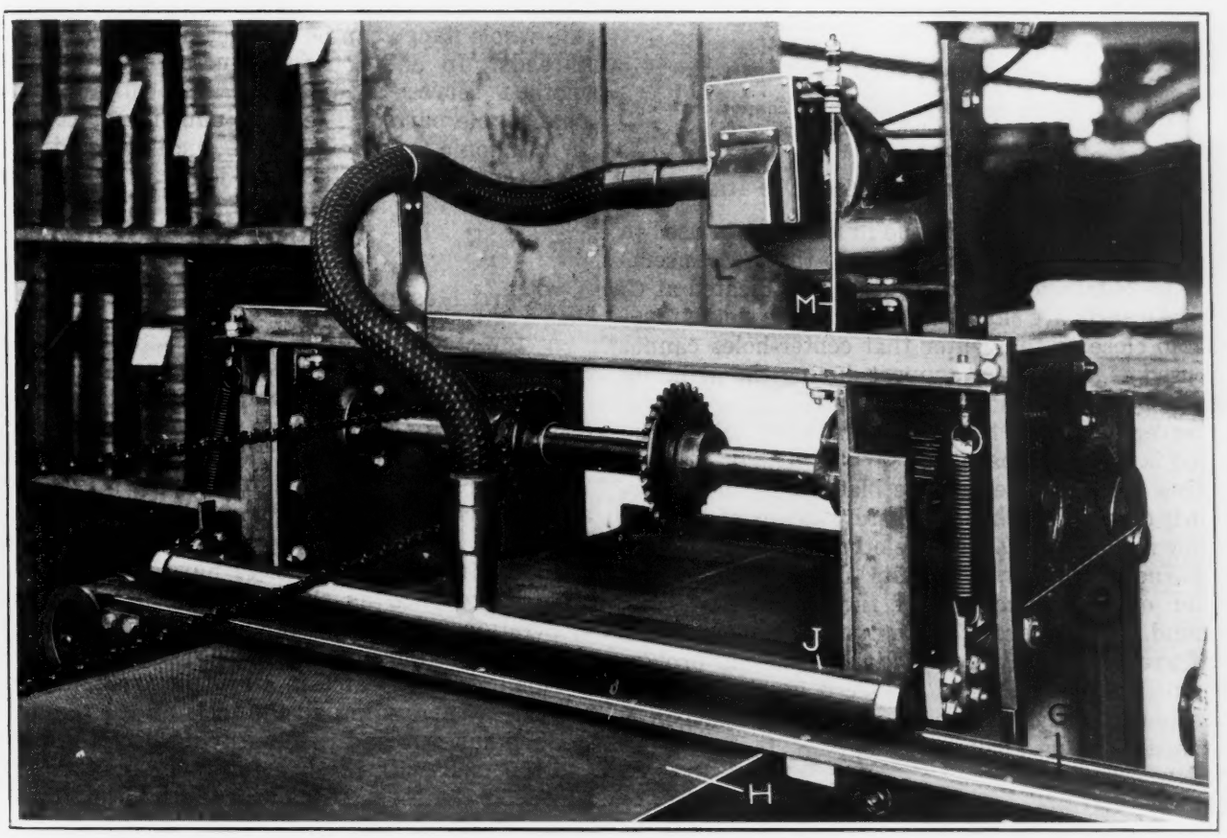


Fig. 2. Mechanism that Transfers the Fragile Disks by Suction from the Pressing Machine to the Baking Oven

Metal-working in Power Presses

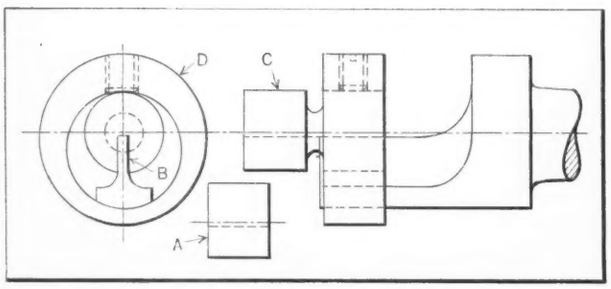
At a recent meeting of the American Institute of Mining and Metallurgical Engineers, E. V. Crane, staff engineer of the E. W. Bliss Co., presented a paper representing a tremendous amount of research on the subject of shearing, bending, drawing, extrusion, and hot-press forging of metals in power presses. The paper, without doubt, forms the most exhaustive study of these operations from a research point of view that has ever been made. In the past, the shearing, bending, and drawing of metals has been largely a matter of trial and error, and it is encouraging to note that the subject has now been attacked from a true engineering angle. The paper may be obtained by addressing the author, care of E. W. Bliss Co., Brooklyn, N. Y.

* * *

Nearly a million dollars was paid to pensioners by the General Electric Co. during 1930. On the last day of the year there were 1287 pensioners, averaging sixty-nine years of age and having been employed by the company for an average of twenty-nine years before retirement. The pension payments in 1930 averaged $817.

Ideas for the Shop and Drafting-room

Time- and Labor-saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work



Arbor for Grinding Die Inserts that cannot be Supported in the Usual Way

Arbor for Grinding Slotted Die Inserts

The insert *A* shown in the illustration is used in a piercing die, and is made up so that two inserts may be obtained from one piece, as indicated at *C*. These inserts are slotted at one side, the slot extending so close to the center that center-holes cannot be used as a means of support during the grinding of the cylindrical surfaces. With the arbor shown, however, they may be held so that each half of the piece is ground separately.

One end is located on the blade *B* of the arbor, and is clamped in this position by means of the set-screw in the ring *D*. At the other end of the arbor is turned a shank which fits the grinding head. After one side and end of the piece have been ground, it is reversed on the arbor and the other half ground, after which it is removed and broken apart. The ragged ends produced by this method of separating the two parts are then finished in a surface grinding machine.

New Britain, Conn. W. C. BETZ

Lapping with Pumice Paste

When two soft metal pieces, such as copper and aluminum, are being lapped together, the use of emery flour sometimes results in the grains of emery becoming embedded in the metal. Afterward, when the parts are assembled, this may cause them to wear rapidly. Pumice powder mixed with oil in the same proportion as the emery flour is recommended by the writer to eliminate this condition. This powder will be found sufficiently abrasive for use on soft metals, and since it is soft itself, is less likely to become embedded in the work.

W. E. WARNER

Herts, England

Aluminum Flanges for Ammonia Pipe Joints

By making the flanges of piping used in ammonia refrigeration work of die-cast aluminum, the machining can be accomplished in a fraction of the time required when cast iron or mild steel is used. In fact, practically no machining is necessary, as the whole flange can be die-cast, including the pipe threads. In addition to reducing the cost, this method serves to maintain uniform and interchangeable parts. The aluminum is not corroded by ammonia, and being more ductile than iron or steel, enables a tighter pipe joint to be obtained.

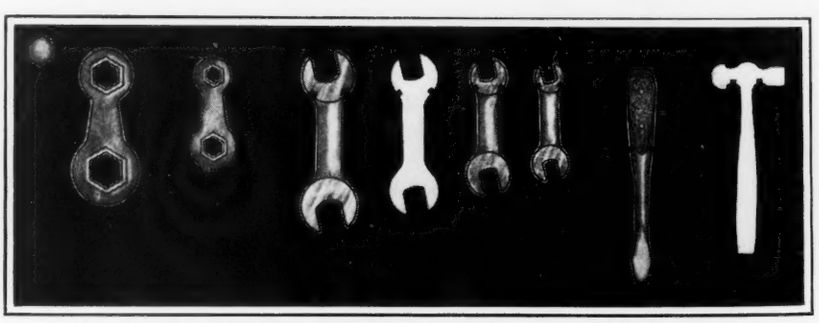
Preston, Victoria, Australia C. J. DROLZ

Board Designed to Keep Tools in Place

A few tools such as wrenches, screwdrivers, hammers, etc., are needed occasionally in every laboratory, testing-room, and drafting-room. It is a simple matter to designate where these should be kept; but, too frequently, the place is a drawer or shelf where the tools are left in a disorderly mess and from which the particular tool required is often missing. A simple method of eliminating such time-wasting conditions is to have the tools kept on a board such as shown in the accompanying illustration, which will show at a glance if any of the tools are missing.

This board is located in a conspicuous place, and is made by arranging all the tools on the plain unfinished surface, and then spraying both the board and the tools with black paint. The paint is then wiped off the tools. The white spaces left on the board have the exact outlines of the tools. A foreman can then tell, at a considerable distance, if the men return the tools to their proper places on the board. A man who needs one of the tools can also ascertain if it is in its place without leaving his desk or bench.

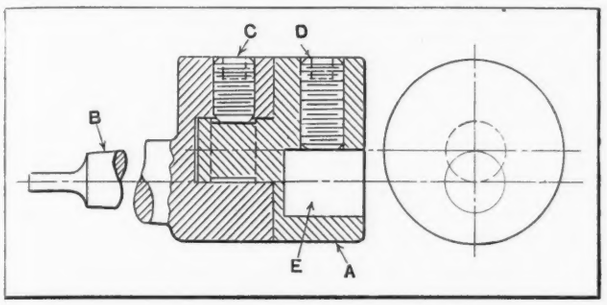
Brooklawn, N. J. CHARLES KLYNE



Board Painted Black with White Profiles which Show Places for Small Tools

Simple Offset Boring Head

The offset boring head shown in the accompanying illustration can be used to advantage for boring small holes on milling machines. The amount of offset or eccentricity can be varied; the smaller the eccentricity, the greater the accuracy and the finer the adjustment will be.



Eccentrically Adjusted Boring Head Used on a Milling Machine for Boring Small Holes

On the adjustable tool-block *A* is turned a concentric projection which is a free fit in an eccentric hole bored in one end of the shank *B*. This projection is relieved slightly along the cylindrical surface, so that the point of the clamping screw *C* will not mar it or prevent it from turning freely.

After assembling both members of the head and securely fastening the tool-block with the clamping screw, the hole *E* is bored concentric with the tapered end of the shank. Next the hole for the screw *D*, used for clamping the boring-bar, is tapped in the tool-block. Two set-screws may be provided here if greater rigidity is required. This offset boring tool can be easily made; it is very rigid, and can be adjusted rapidly. Although the tool clearance will change with the different positions of the tool-blocks, the change is so slight that it may be disregarded.

Detroit, Mich. FRANK X. SOMMERS

Preventing Lead from Adhering to Steel Parts

The writer has used the method of preventing lead from adhering to steel parts described in December MACHINERY, page 286. Both mixtures mentioned were found effective, although, as stated, the alcohol and whiting mixture is superior to whiting and water. A simpler process, although not quite so efficient, is to immerse the work in salt water or brine. The work is first placed in the lead bath until it has become heated to about a blue color, which requires but a few seconds for small pieces. It is then plunged quickly into the salt water solution, withdrawn, and allowed to dry completely, the drying being accomplished quickly by the internal heat.

This process leaves a white coating on the surface of the parts, which prevents the lead from adhering. The density of this coating depends on the amount of salt added to the water; a sufficient amount should, of course, be used to produce a fairly heavy coating. After being coated in this way, the work is replaced in the lead bath, care being taken to see that any moisture remaining on the surface is not forced into the hot lead, which would cause an explosion or spattering. This process is inexpensive and simple to apply, and has been used successfully for some time. The frequent removal of dross from the surface of the lead bath and the generous use of coal or charcoal on the surface of the bath will also help prevent the lead from adhering to the steel.

Millersburg, Pa. R. A. DRESSLER

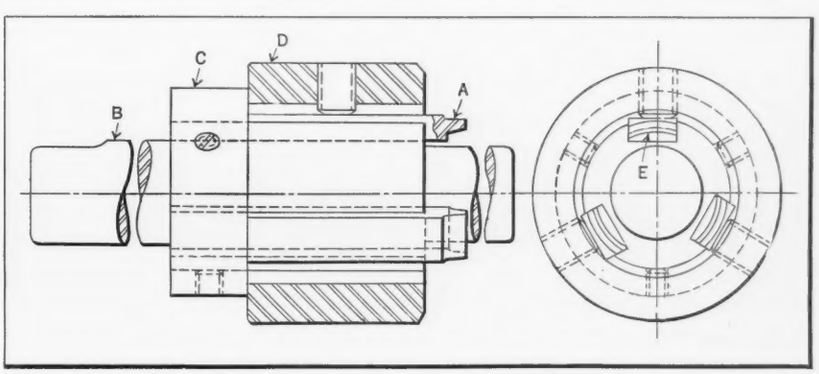
Arbor for Turning Clearance on Cutters

In one shop, instead of filing the clearance on the cutters shown at *A* in the illustration, they are mounted in a special arbor and the clearance is turned in a lathe. These cutters are used in a forming tool for recessing padlock cases. The arbor consists of member *B*, the collar *C*, and the clamping ring *D*. Member *B* is slotted to receive three cutters, comprising a complete set as used in the forming tool. The slots are equally spaced but are offset from the center line of the arbor a sufficient amount so that the required clearance will be provided on the cutters.

In operation, the cutters are placed in the slots of member *B* and clamped in position by means of set-screws in the clamping ring *D*. The ends of the cutters rest against the collar *C*, which serves as a stop. A standard dog is used for driving the arbor between the lathe centers.

For turning the clearance under the cutters at *E*, an offset turning tool is used, while the outside clearance is machined by a regular lathe tool. It is obvious that by offsetting the grooves in member *B*, the clearance turned on these cutters will be similar to that produced by means of a backing-off attachment.

Stamford, Conn. JOSEPH ABBAZIA



Arbor for Holding Forming Cutters while Clearance is being Turned

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

R. F.—In a round-hole perforating machine, such as is used for perforating postage stamps, it is necessary to harden the die-plate to insure clean cutting for a considerable period. The die-plate is perforated with a row of small holes (approximately No. 62 wire gage, sixteen holes per inch), and the problem in hardening is to maintain the holes in line with one another, and with the correct center distances between them.

Will someone who has accomplished work of this nature successfully furnish particulars of the hardening process? Information is also desired regarding the equipment used for boring the holes in the pin plate and guide plate.

Dies for Blanking Mica

P. A.—Can you tell me if the cutting edge and the clearance for dies used in blanking out mica are the same as for dies used in blanking metal?

A.—Closely fitted dies, that is, dies having a small clearance between the cutting edges, are required to obtain clean-cut blanks from sheet mica. The cutting edges must be sharp and the clearance must not be over 0.001 or 0.002 inch. The thinner the material, the smaller must be the amount of clearance, 0.002 inch being about the maximum clearance for mica 1/16 inch thick. Probably any well made close-fitting die that produces good smooth-edged blanks from thin, tough sheet metal will also give satisfactory results when used on sheet mica.

Most Economical Number of Parts per Run

E. N.—Some companies have found themselves with too large inventories of finished parts because they have attempted to save in production costs by producing in quantity. I believe that years ago a formula was published for calculating the number of parts that it is economical to make at one time. Would it not be advantageous to republish this formula?

A.—The formula to which our correspondent refers is the one published in November, 1925, MACHINERY, page 182, in an article on the subject by John M. Christman; the formula is also published in MACHINERY'S book "Successful Shop Management." In the article referred to, the author pointed out that nearly all manufacturing concerns are confronted with the problem of determining how many parts of one kind should be made before breaking down and resetting for another part. It is evident that the set-up cost per part is less as the number of parts in a run increases; therefore, if there are too few pieces in a run, the part becomes very costly. It is also evident that if too many pieces are made in a run, the pieces will be in storage a long time before they are used, and the cost of the part will be increased due to interest on money invested in parts and storage space cost. Therefore, too many pieces in a run will also make the parts very costly.

If too few or too many pieces are made in one run, the parts become more costly. There is, however, one quantity where the sum of the set-up cost and the increased cost due to interest and floor space is a minimum, and this is known as the "economical cycle." By the use of higher mathematics it can be proved that:

$$\text{Economical Cycle} = \sqrt{\frac{BFD \times 560}{C \times (D - F) \times A}}$$

In this formula,

B = total cost of set-up, in dollars;
F = number of parts used per day;
D = number of parts that can be made per day;
C = total cost of material, labor, and overhead per part; the set-up cost per part can be neglected at this point, as it would change the economical cycle but little;
A = fraction by which the cost of the part is increased if kept in storage for one year; this increase is caused by interest on money invested, insurance, and value of floor space. For example, assume that C equals \$0.25, the interest rate is 6 per cent, and insurance and floor space costs \$0.01 per part per year; then the cost of one part, if in storage one year, would be increased $0.25 \times 0.06 + 0.01 = 0.025$, which equals 10 per cent, or $A = 0.1$.

To explain the use of the formula, assume that $B = \$16$, $F = 20$, $D = 200$, $C = \$0.25$ and $A = 0.1$ (10 per cent). Then

$$\sqrt{\frac{16 \times 20 \times 200 \times 560}{0.25 \times (200 - 20) \times 0.1}} = \sqrt{7{,}964{,}444} = 2822$$

or 2800 approximately.

If the parts in the problem considered were made in lots of 2822 pieces, the set-up cost per part would be $16 \div 2822$, or \$0.0056. Since $\frac{2822}{20}$ days are required to use the parts in the cycle, and $\frac{2822}{200}$ days

are required to make the parts, it is evident that the last part made would be in storage $\frac{2822}{20} - \frac{2822}{200}$ days. The first part made is in storage no time.

Knowing the time the first and last parts are in storage, the average storage time can be obtained by taking one-half of the sum, thus: $\frac{1}{2}\left(\frac{2822}{20} - \frac{2822}{200}\right)$ days. Taking 280 as the number of production days per year, the average time would be $\frac{1/2}{280}\left(\frac{2822}{20} - \frac{2822}{200}\right)$ years.

Since the storage and interest increase the cost of the parts 10 per cent per year, the storage charge on the parts would be

$$0.25 \times 0.1 \times \frac{1/2}{280}\left(\frac{2822}{20} - \frac{2822}{200}\right)$$

or $0.0056 per part. It can be seen that the set-up cost, $0.0056, and the storage charge, $0.0056, are equal when the most economical number of parts are made. This can be proved mathematically, but requires a very complicated mathematical analysis.

Machinery Approved by Firm's Representative

A. M. J.—Several months ago we received a properly signed order for over $175,000 worth of machinery to be specially built. On account of the fact that certain parts of this machinery had to be constructed with exactness, the buyer sent an expert from his factory. This expert told us that he was authorized to supervise the construction work and to approve the machinery as it was completed. Litigation has since developed over payment for this machinery. The buyer contends that it is not satisfactory. We communicated with him, explaining that the expert from his factory had approved our work as it was being done, but the seller states that this expert was authorized only to hasten our work and that he had no authority to approve the work. What is the law in this case?

Answered by Leo T. Parker, Attorney at Law
Cincinnati, Ohio

Under the circumstances, you are entitled to recover payment for the machinery approved by the expert. It was the buyer's duty to inform you of the extent of the authority placed in the expert. In a parallel case (285 S. W. 516), a seller submitted to a prospective buyer samples of his product. Later the buyer signed an order and sent a man to the seller's plant. This man stated that he came to inspect and approve the completed product. The purchaser refused to pay for the delivered merchandise, contending that it did not equal the samples submitted. The seller sued to recover the contract price, and the Court held the buyer liable, because his man had approved the product at the seller's plant. In speaking of the authority of an agent sent to a seller's factory, the Court said:

"One rule seeks to protect principals against wrongful assumptions of authority of agents, and to do this gives special weight to the doctrine that a man has the right to extend or restrict the powers of his agent as his judgment dictates. The other rule seeks to protect the public against losses due to the appearance of power in an agent, and therefore emphasizes the maxim that, where one of two persons, both free from a fraudulent motive, must suffer loss in consequence of the act of one of them, he whose innocent act entailed the loss must bear it. This principle lies at the root of most of the rules concerning the apparent authority of agent."

Die for Drawing Deep Shells

J. S. D.—Will some reader who has had experience with drawing dies for producing the shell shown in January MACHINERY, page 368, show the design of a die that has given satisfactory results on this class of work?

Answered by Edward Heller, Cleveland, Ohio

As a reliable guide in designing the tools for making this shell, it is suggested that MACHINERY'S book "Die Design and Diemaking Practice" be referred to. Beginning on page 515 of this book, the proper blank size, the design of drawing die, the permissible reduction, and the number of draws required may be readily obtained. Line drawings of suitable dies for this job are shown on pages 606 and 607. If the shell is required to be trimmed, the method of trimming used in the dies shown on page 578 may be employed to advantage. Other dies suitable for this job are also illustrated and described, leaving a wide choice for the designer's selection.

How is Tapered Tubing for Golf Clubs Made?

A. A. L.—What is the best method of making tapered tubing for golf clubs from straight steel tubing?

This question is submitted to MACHINERY'S readers.

* * *

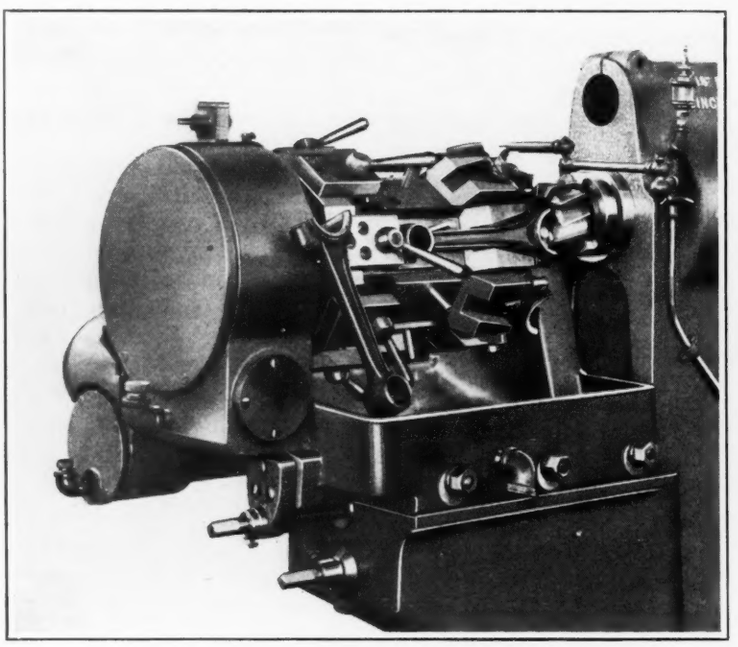
German Publication Devoted to Research

The Society of German Engineers (Verein Deutscher Ingenieure) has begun the publication of a monthly journal devoted entirely to research in the field of engineering. This publication will place on record the methods used and the results obtained in research work in every branch of the engineering field. Books on subjects closely allied to research will be reviewed and important articles published in the engineering press and papers read before engineering societies will be briefly abstracted. The name of the new publication is *Forschung* (Research).

Drum Type Fixtures Increase Milling Machine Output

Production on standard plain milling machines is increased to an unusual degree by employing fixtures of the drum type. Because of their rotary design, application of these fixtures at once converts a plain milling machine into a continuous milling machine, and the cost of the added equipment is relatively low. A recent installation of this kind is shown in the illustration. The parting faces of connecting-rods and their caps are finish-milled in one operation with this set-up.

In this case, the fixture is mounted on the knee of an 18-inch plain manufacturing Cincinnati miller; the drum, which is about 11 inches in diameter, is rotated continuously, being driven by a universal shaft from the gear-box used for the regular table feed. With this arrangement, eight feeds for each spindle speed are available.



Standard Milling Machine Equipped with Rotary Drum Fixture for Obtaining Continuous Production

Four connecting-rods and four caps are spaced alternately around the eight stations provided on the drum; they are located endwise by a solid pin which comes in contact with the bottom of the split bore of each part, the pins being shaped on one side to conform to the contour of this bore. Each part is clamped in position rapidly by means of an individual cam-operated slide actuated by a short hand-lever on the driving end of the drum. Projections on these slides act on the bolt bosses of the connecting-rods and force them against the locating pins.

The operation of the fixture is simple, the operator merely shifting a lever to load and unload the work while the other parts on the drum are being milled. Adjustment for depth of cut and compensation for cutter wear are made by moving the fixture endwise on the knee, the regular saddle hand feed-screw being used for this purpose. In this set-up, the work feeds past the end-mill at the rate of 37 inches per minute, giving a production of 442 parts per hour—a production not possible to obtain except with a special fixture.

Avoiding Unemployment in Future Depressions

In an article entitled "The Problem of Unemployment," published in the *Executives Service Bulletin*, issued by the Metropolitan Life Insurance Co., New York City, Daniel Willard, president of the Baltimore & Ohio Railroad Co., suggests the following six points which should be taken into consideration in order to avoid unemployment in future periods of business depression:

First in importance, there should be a definite and sympathetic realization on the part of society as a whole that, if society is to receive the benefits of our modern industrial system—and they are very great—it must bear the responsibilities that are inseparable from those advantages.

Second, we should do all that properly may be done to make life on the farm more attractive and more satisfying, to the end that a larger percentage of our people may wish to avail themselves of the advantages and opportunities enjoyed by the independent and prosperous farmer who lives on and cultivates his own soil.

Third, the Government—State or Federal, perhaps both—should collect, tabulate, and publish currently reliable information concerning the number of people who are unemployed and the cause of such unemployment.

Fourth, efforts to develop our foreign trade should be encouraged, thus increasing the demand for our products abroad.

Fifth, the Government, State and Federal, should plan and execute its public works program in such a manner as to form a reserve against unemployment in times of depression.

Sixth, private industry should recognize the responsibility that properly rests upon it to stabilize employment within itself.

* * *

Approximately one-sixth of the passenger cars built in the United States are exported and one-third of the commercial cars are sold abroad.

The Development of Automatic Internal Grinding

The subject of automatic internal grinding was dealt with at length by Harold L. Blood of the Heald Machine Co., Worcester, Mass., in a paper read before the Machine Shop Practice Division of the American Society of Mechanical Engineers at a meeting held in Newark, N. J., Thursday evening, March 19. Mr. Blood covered the development of internal grinding from its inception, showing the first type of machine used for this purpose—a universal grinder designed for external, face, and internal grinding.

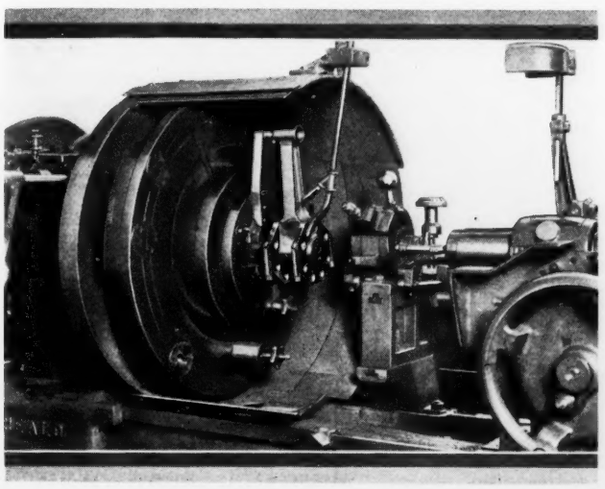


Fig. 1. Grinding the Articulating Rod Holes in Airplane Engine Master Rods. Two Grinding Wheels on the Spindle Finish the Two Opposite Articulating Rod Holes at One Time, Thus Assuring Perfect Alignment of the Two Holes

From this early development he traced the gradual improvements in machines and methods up to the present time, with its fully developed automatic machines. He also reviewed the different methods that have been employed for gaging the bores of ground holes, following this development through its various stages up to the wholly automatic means now being used, of which he cited the "Size-Matic" and the "Gage-Matic" principles as examples.

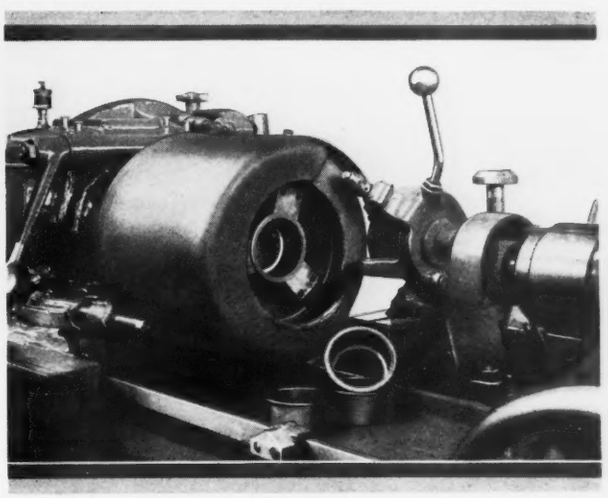
He called attention to the accuracy obtainable by present-day methods, stating that when a "sparking out" device is used, holes can be ground on a production basis with an average out-of-roundness of only 0.00005 inch (that is, "half a tenth"). He emphasized that it is now much easier to grind a hole to this degree of accuracy than it is to measure the error.

Through the application of ball bearings, extremely high speeds are now being used for the wheel-heads. In regular practice, speeds from 10,000 revolutions per minute for 1-inch spindles and larger, up to 25,000 revolutions per minute for 7/16-inch spindles are being employed.

Having described the general development of automatic grinding machines and the methods employed, Mr. Blood described briefly a number of outstanding production jobs, illustrating each with lantern slides and giving production figures as well as the limits of accuracy obtained. The paper was illustrated with some forty lantern slides, covering the subject in an unusually complete manner.

In conclusion, the author pointed out that the term "automatic" in connection with internal grinding machines has been so loosely used as to be confusing, and emphasized that an internal grinding machine is automatic only when it "sizes" the work automatically.

Fig. 2. Grinding Cast-iron Drive Shaft Housings to Form a Seat for Ball or Roller Bearings. The Hole is Ground and the Shoulder Faced in This Operation. One Operator Runs Two Machines, Producing Thirty Parts per Hour



* * *

Italian Machinery Imports

The machinery imports into Italy were well maintained during the first six months of 1930, considering the widespread complaints of general business conditions. A. A. Osborne, assistant commercial attaché at Rome, reports that the imports of machinery and equipment amounted to nearly $25,000,000, as compared with about $26,000,000 during the first six months of 1929. According to *Commerce Reports*, the imports from France, Great Britain, Switzerland, and the United States suffered, while those from Germany increased slightly. The imports from the United States were valued at $2,900,000. In spite of the depression, there is considerable interest in American equipment.

Design of Machine for Bending Copper Pipe

Hand-operated Machine for Bending Light-gage Copper Tubing without Wrinkling or Flattening the Bent Portion

By PAUL H. WHITE

CONSIDERABLE experimental work is usually required in developing a satisfactory method for bending pipe on a production basis. Some of the factors to be considered are the structure of the material to be used, effect of bending on the structure, thickness of pipe walls, radius of bend, allowable limits of accuracy, preparation of material for the bending operation, and rate of production required. Materials which, from visual inspection, seem to be identical, sometimes give widely different results. Unless raw material of a uniform quality which has been found to give good results is obtainable, the finished product will be unsatisfactory.

In MACHINERY, December, 1929, page 275, the author described a power-driven machine for cold-bending steel pipe. The machine described in that article is employed in a plant where one or two carloads of pipe each month are worked up into continuous hair-pin bends such as are used for water-heating systems. Power for driving this machine is obtained from an electric motor.

In the present article, the design of a hand-operated machine for bending light-gage copper tubing without wrinkling or flattening the bent portion is illustrated and described. When light-gage seamless drawn copper tubing is to be bent, a different principle must be applied in designing the bending equipment from that employed in designing equipment for bending steel pipe of reasonably heavy gage. If pressure is applied to the outside of the thin copper tubing, the walls, being too weak to retain their shape against the pressure, will either collapse, become wrinkled, or be formed into a square bend at one point. Hence it is obvious that some means must be used to support the walls of the tube from the inside in order to prevent a change in the cross-sectional form. This is sometimes done by filling the pipe with sand or rosin. These materials must be tightly packed and the ends of the pipe plugged. However, this process is entirely too slow for quantity-production requirements.

The machine shown in the accompanying illustrations was developed for making return bends like the one shown at *W*, Fig. 1. The seamless drawn tubing bent in this machine has a wall thickness of approximately 0.030 inch. The tubing, as received, is in the same condition as when it made its final pass through the drawing die and is, therefore, too hard to be bent without annealing. The annealing is done locally, however, including only the part of the pipe that is to be bent.

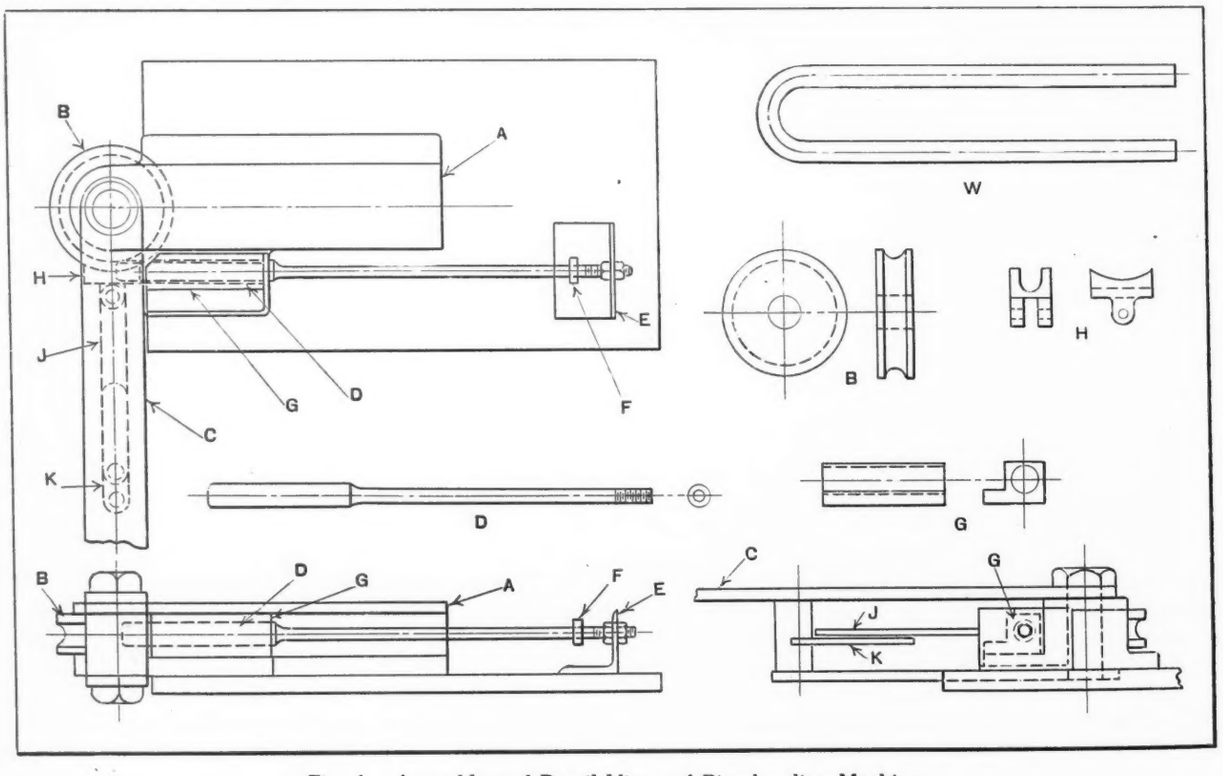


Fig. 1. Assembly and Detail Views of Pipe-bending Machine

In addition to the three views of the assembled bending machine shown in Fig. 1, some of the parts are illustrated in separate views. These parts are identified by the same reference letters as in the assembly views. The various parts that constitute the bending machine are assembled on the base *A*. The grooved roller *B* is free to turn upon a center stud, which also forms a pivot for the bending arm *C*. The groove in roller *B* is made to fit the semi-circumference of the tubing, and the diameter at the bottom of the groove is made to correspond with the inner width of the finished bend.

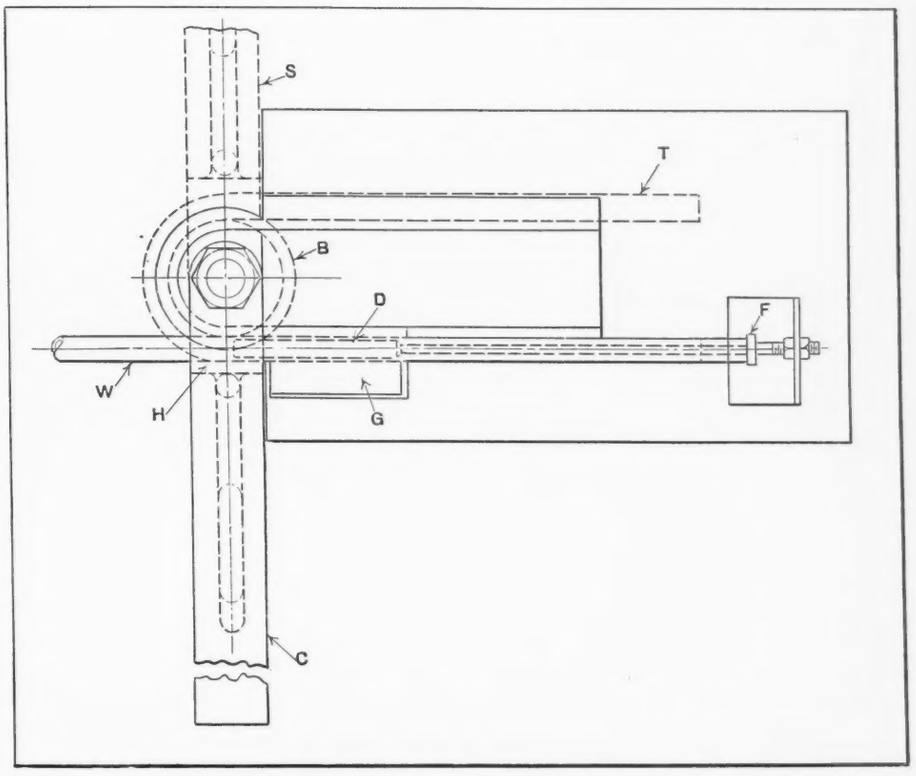


Fig. 2. View Showing by Dotted Lines the Positions of the Work and Operating Lever at the Completion of Pipe-bending Operation

The tube is supported on the inside by the mandrel *D*, which prevents it from collapsing. This mandrel is made to fit the inside of the tube with just sufficient clearance to avoid binding. It is held in the proper position by a long shank or rod. The position of the mandrel can be adjusted by means of the threaded nuts located on each side of the bracket *E*. An adjustable collar *F*, mounted on the shank of the mandrel, acts as a stop for gaging the distance from the end of the tube to the bend.

The mandrel passes through a guide block *G* located close to the roller *B*. Block *G* serves as a support for the outside of the tube as well as a guide while the bend is being made. The hole through the guide block has sufficient clearance to permit the tube to slide through easily.

On the under side of the bending lever *C* is a clamp *H*, which can be moved in and out by the links *J* and *K*. This clamp, as shown in the detail view, is finished to a radius corresponding to the outside radius of the grooved roller *B* and is also grooved to fit the outside semi-circumference of the tube. This machine is mounted at the end of a strong wooden bench and is hand-operated, although it would be a comparatively simple matter to adapt it for a power drive.

Operation of the Bending Machine

The operation of the pipe-bending machine will best be understood by referring to the assembly plan view, Fig. 2. In this illustration, the tube *W* is shown in position ready to be bent. The position of the bending arm *C* and the form of the work *W* at the completion of the bending operation are indicated by the dotted lines at *S* and *T*, respectively. The tube *W* is cut to the proper length, and is pushed through the guide block and over the mandrel, where it is located against the stop-collar *F*. Then the clamp *H* is brought up against the tube and the bending arm *C* swung through an angle of 180 degrees. When the bending operation is performed, the portion of the tube projecting to the left of the clamp remains straight and is carried around the roller *B* ahead of the clamp *H*, while the portion to the right of clamp *H* is drawn forward through guide block *G* and over the mandrel *D*.

The entire forming action takes place at the point where the tube leaves the mandrel, and since the inside of the pipe or tubing is supported at this point, where the bend occurs, the tubing is prevented from collapsing. A certain amount of adjustment is required to bring the end of the mandrel to exactly the correct position. When the mandrel is correctly located, however, it will support the tubing so effectively that a cross-section through the bent portion will be practically the same as a section of the unbent portion.

* * *

The application of industrial photography will be considerably broadened by a new film brought out by the Eastman Kodak Co. By the use of this film, it will be possible to make pictures with from 1/3 to 1/5 as much artificial light as was needed in the past; or. if the customary amount of light is used, it will be possible to obtain the picture with a correspondingly shorter exposure. Plant photography will be simplified by the introduction of this film, as flashlights will not generally be required to obtain a good picture.

Present-day Nickel-plating Practice

A Review of the Methods Now in General Use, with Recommendations for a Closer Control of Temperature, Current Density, and Acidity

At the last annual meeting of the Society of Automotive Engineers, the Non-ferrous Metals Division presented a report giving general information on nickel-plating. The nickel-plating process has been in commercial use since 1840; yet, even today, there are many factors that are not thoroughly understood and that cause difficulties. Compared with chromium-plating, for example, nickel-plating is a comparatively easy process; that is, a deposit of nickel may be obtained under widely differing conditions; but the *best* results are obtainable only where there is the proper combination of conditions. Chromium-plating, again, requires careful control of all the factors—the composition of the bath, its temperature, and the current density. Without this careful control, chromium-plating is impracticable.

The nickel-plating baths in commercial use differ greatly in composition, but most of them contain varying quantities of nickel-sulphate, with a small quantity of some chloride, such as nickel-chloride or sodium-chloride. For use in plating zinc-base metals, it is common practice to have the bath also contain large quantities of sulphates other than nickel, such as sodium-sulphate or magnesium-sulphate. Three typical nickel-plating baths are given in the accompanying table.

Composition of Three Typical Nickel-plating Baths

Constituents	Grains per Liter of Solution		
Nickel sulphate, $NiSO_4.7H_2O$	200	..	75
Nickel ammonium sulphate, $NiSO_4.(NH_4)_2SO_4.6H_2O$	..	75	..
Ammonium chloride, nickel chloride or sodium chloride	30	15	15
Sodium sulphate, $Na_2SO_4.10H_2O$	..	..	150
Boric acid	30	15	15

Besides the materials mentioned, many platers add different materials such as acetic acid, citric acid, sodium citrate, hydrofluoric acid, nickel fluoride, or Rochelle salts. The advisability of such additions is open to question.

At present, most nickel-plating is done in baths that are at room temperature and at current densities of not over 20 amperes per square foot. There is a general idea that the acidity of the nickel-plating baths should be controlled with a value of about pH 5.7. Recent work has shown that the factors of temperature, current density, and acidity may all be varied, but that these factors are just as important in nickel-plating as in chromium-plating.

Difficulties Encountered in Nickel-plating

The principal troubles encountered in nickel-plating are roughness, peeling of the plate, and pitting. Roughness appears to be caused by certain insoluble materials in the bath. Removal of these impurities by filtration usually corrects this trouble. "Bagging" the anodes is sometimes used as a preventive measure.

Peeling is caused primarily by improper control of temperature, current density, and acidity, and, to a less extent, by improper cleaning. It has been found that the troubles due to peeling are decreased if a hydrochloric-acid dip followed by a rinse in clear water comes between the regular cleaning operation and the actual nickel-plating.

Pitting is probably the most common trouble in nickel-plating at present. Many theories have been advanced to explain pitting, but in most cases its prevention involves either greater care in cleaning prior to plating, reduction in the density of the current, or the use of oxidizing agents in the nickel-plating bath.

When resistance to corrosion is required, two plates composed of nickel and some other metal, such as copper, will usually give better results than a single plate of nickel of the same total thickness. For outdoor exposure on steel, the total thickness of plate should be 0.001 inch or more, with the nickel at least one-half of the total plate. When chromium is to be applied over nickel, the nickel should be plated under conditions that give good adhesion of the nickel-plate, and the nickel-plate should be thick enough to resist the tendency of the chromium-plate to cause peeling of the nickel.

In general, the bright polish on nickel-plate is obtained by buffing, but in some cases where the exposure conditions are so mild that the greater durability of a heavy buffed deposit is not required, a "bright" nickel-plate is obtained by proper control of the plating bath and plating conditions. These factors may involve the use of a small amount of cadmium or other addition agent in the bath, the use of low temperature and low current-density and the deposition of an extremely thin plate.

Equipment for Nickel-plating

Many kinds of tanks have been used for nickel-plating, with wood, either pitch or lead lined, predominating. At present, steel tanks with rubber linings are coming into use and seem to be giving satisfaction. For plating at high temperatures, lead-lined or rubber-lined tanks are superior to the pitch-lined ones.

Various kinds of anodes have been used for nickel-plating and many troubles have been attributed to the use of improper anodes, but there is no general agreement upon an anode composition that will meet the widely varying conditions in the industry; hence no recommendation can be made.

The necessity of technical control of chromium-plating has called attention to the desirability of technical control in plating of all kinds, and it is probable that the more general application of technical control to nickel-plating will result in clearing up some of the troubles now experienced.

The Coordinator in Cooperative Trade Education

By TRAVER C. SUTTON, Wilbur Wright Cooperative High School, Detroit, Mich.

During recent years a new plan of education has been introduced in the United States—the so-called "cooperative" method of industrial education. This plan has been applied both to high school and to technical college education. Briefly, the plan is based upon the principle of having the students work for two or four weeks in the classroom and then for two or four weeks in factory work in the industry for which they are being trained.

Detroit has recently introduced this method of education, and has built the Wilbur Wright Cooperative High School for the sole purpose of giving boys an opportunity to obtain a high school education and mechanical training at the same time. A number of the leading industrial plants, including the largest automobile factories in Detroit, are cooperating with the public school authorities in carrying out this plan.

To insure the success of the cooperative plan of education, it is necessary that a "coordinator" be employed by the public schools, whose duty it shall be to coordinate the school work and the practical shop work, so that the student will derive the greatest benefit from both. The chief duties of the coordinator and the problems confronting him may be stated briefly as follows:

1. The employer must be convinced that this method of apprenticeship can be operated to his advantage. The success of the cooperative apprenticeship system depends on the attitude of the shop in which the boy is employed during the periods when he is not in school. Hence, cooperative education cannot be forced upon industry by law. A friendly attitude on the part of the employer is the key to success. In the majority of cases, the employer's sentiment toward cooperative education is more favorable than his ability to put this sentiment into practice. The coordinator must be a man who will command the respect both of the employer and of his superintendents and foremen. He must also have an understanding of industrial problems if he is to be successful in winning the confidence of the shop where the boys are being employed.

2. A representative advisory committee consisting of employers must be organized, and this duty generally falls to the lot of the coordinator. Such a committee is of the greatest importance, because employers will take more interest in the cooperative plan if they feel that the responsibility for success is partly theirs.

3. The students must be given an opportunity to discuss their problems and to relate their experiences. This necessitates a system of records and reports. Certain hours must be set aside for this "coordination" work.

4. During periods of depression and unemployment it happens in some localities that the students cannot be employed continuously in the industry. This is especially true when a large group of students is placed with a comparatively small number of employers. In such a case, the percentage of students that must be laid off may be quite large. The only method by which this problem can be met is to provide work of a vocational character in a school shop equipped for the purpose. It has sometimes been said that the cooperative school does away with the expense of equipping and maintaining a school shop. This may be true in some localities, but it is not true everywhere. A school shop is necessary in cities of an industrial character, such as Detroit. In times of depression, such a shop can also be used to give the prospective students preliminary training and to give a broader training to students employed in machine shops on highly specialized operations.

5. One of the most important duties of the coordinator is to see that the student is given more and more important work in the industrial shop, so that he will feel that he is gaining experience month by month. Here, again, good records are necessary. The coordinator's time should not be taken up with directing an elaborate filing system, but the records should be kept in the main office of the school under the direction of the regular school office staff. If an employer can be shown definitely that a boy has been kept too long on one job, he will, in almost every case, gladly cooperate by providing for a change of work. Here, too, the committee of employers becomes of great importance, because the coordinator cannot assume the role of a dictator.

The coordinator's job is at best a difficult one. It can be handled successfully only by a man who has worked in industry, himself, and who knows its problems. In addition, he should have a broad educational experience and training along general academic lines, for he is the one man who must be able to answer the question, "How can practical work and academic education be combined most successfully?"

A Rating Card for Toolmakers and Machinists

By WILLIAM C. BETZ, Master Mechanic
Fafnir Bearing Co., New Britain, Conn.

I have always wondered why mechanics are paid rates practically fixed within narrow limits instead of being paid according to their ability to produce and their skill. Often highly skilled men are slow, while some of the fastest men have less skill; therefore, when a man has both speed and skill, he ought to be paid accordingly.

In the average tool-room, the foreman will tell you that some of his men produce a great deal better and a great deal more work than the rest of the men, but these exceptional men are paid, at best, from ten to twenty cents an hour more than the rank and file. In some cases, they produce twice the amount of work of the average toolmaker in the same time, with little, if any, supervision.

A good way to rate men is to use a card like the one shown in the accompanying illustration. Each man is rated according to his skill and his ability to produce, and should be paid accordingly. This system stimulates men to develop exceptional skill and speed. Furthermore, it eliminates the need to ask for a raise in pay, as it will be taken care of automatically in accordance with the rating. Skill is estimated in percentage, perfect skill being 100. Speed is estimated in the same way, the highest possible speed of any man being 100. The average is the theoretical mean of the two previous estimates. A certain base rate of pay should be predetermined, corresponding to each 5 per cent of the average rating, and this would be the basis on which a man's wages would be determined. For example, assume that a man were rated at 70 per cent skill and 80 per cent speed; the average would be 75 per cent. Assume that the base rate is 5.5 cents per hour for 5 per cent rating; his hourly rate for 75 per cent average ability would be 15 times the base rate, or 82.5 cents per hour.

Name	Clock No.
Entered Employ	Rate per hour
Class of Work	
Skill, per cent	Date
Speed, per cent	Date
Average, per cent	Date
Base Rate	cents for each 5 per cent of average rating.

Information Given on Card Recording the Rating of Skill and Speed of Toolmakers and Machinists

These cards should be checked once a month against the man's record. Sometimes a man may fall behind his previous rating. If such a condition develops, an effort should be made to bring him back to his former standard; but if this is impossible, his hourly rate will have to be reduced.

The percentage rating for speed can be arrived at through time studies. The skill percentage requires judgment on the part of the foreman and inspector, who should cooperate in establishing this percentage. The writer also believes that 5 per cent should be added to a man's average rating for each five years of service with the company.

Rochester Unemployment Insurance Plan

Fourteen manufacturing companies in Rochester, N. Y., have adopted what is known as the Rochester Unemployment Benefit Plan under which each company will begin immediately to set up a reserve fund to take care of unemployment due to business conditions in the future. The following companies have joined in adopting the plan: Eastman Kodak Co., Bausch & Lomb Optical Co., Stromberg-Carlson Telephone Mfg. Co., Taylor Instrument Co., Consolidated Machine Tool Co., Todd Co., Rochester Telephone Co., Gleason Works, Vogt Mfg. Co., Cochrane-Bly Co., Davenport Machine Tool Co., Yawman & Erbe Mfg. Co., Sargent & Greenleaf Co., and Pfaudler Co. These companies employ 26,000 people in normal times.

Under the plan, each company will accumulate its own unemployment fund by setting aside up to 2 per cent of its payroll annually, the exact amount depending upon the degree of stabilization attained by the manufacturing enterprise, as indicated by past experience. The fund will be permitted to increase until it reaches a maximum equal to five annual appropriations. In normal times the entire expense will be borne by the company, with no contributions from the employes. During periods of extended unemployment, however, the fund, as an emergency, will be supplemented by contributions of 1 per cent of the wages of all officials and employes not receiving benefits, the company agreeing to contribute during such emergency periods an equal amount.

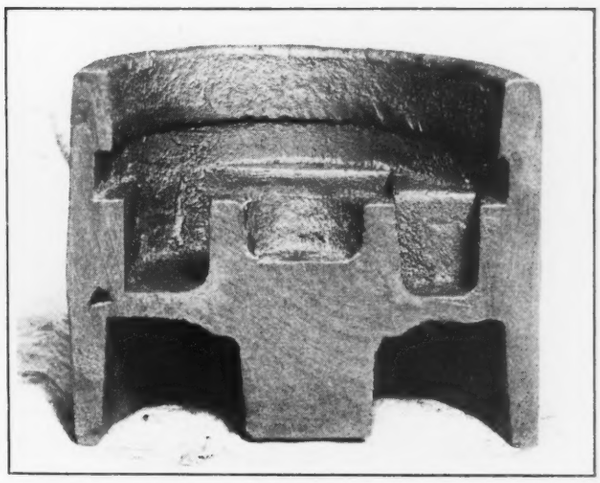
All employes who have been in the service of a company one year or more, and receive less than $50 a week, will be eligible to receive unemployment benefits. These benefits will amount to 60 per cent of the normal pay, with a maximum of $22.50 a week. The period during which these benefits may be received varies from six weeks for employes with one year's service to thirteen weeks for employes having five years' service or more. The unemployment benefits will be paid after two weeks of unemployment. Benefits will also be paid to workers who are employed only part time.

If an employe is able to obtain temporary work outside the plant while he is unemployed in the plant, he will still be eligible to receive the unemployment benefits, provided that his benefit payments and temporary earnings together do not exceed his normal earnings.

James E. Gleason, president of the Gleason Works, is chairman of the Industrial Management Council of Rochester, under whose auspices the plan has been adopted.

Sharp Corners in Castings

The accompanying illustration, republished, by permission, from *Research Group News*, issued by the Electric Steel Founders' Research Group, 541 Diversey Parkway, Chicago, Ill., shows the importance of rounded corners in castings. On the left side, the dark triangular area is a shrinkage cavity caused by the sharp corners adjacent to it. On the right-hand side, where fillets are provided, the casting is sound. The part was purposely made different on the two sides to illustrate the harmful influence of sharp corners.



Shrinkage Cavity Indicated by Dark Triangle at Left is Caused by Sharp Corners in Casting

* * *

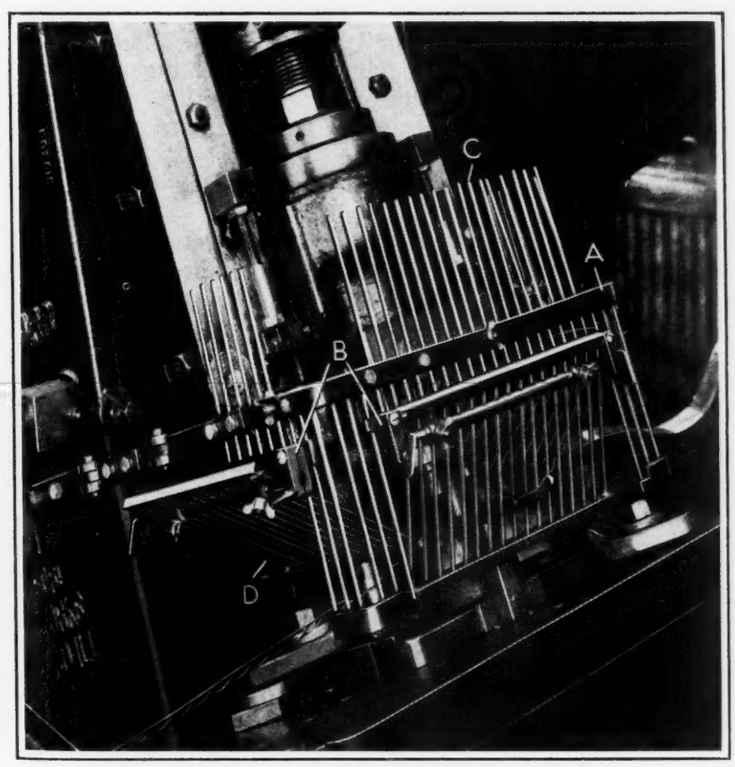
Punch Press Guard Adjustable to Die Size

No matter what size of die is applied to punch presses in the shop of the Allen-Bradley Co., Milwaukee, Wis., the guards with which the machines are equipped can be quickly adjusted to suit the die dimensions. This prevents an operator ever being handicapped by a guard that is much larger than the die in use.

Guards of the design shown in the illustration are used almost exclusively. They consist of a frame *A*, which is attached to the column of the press, and various adjustable members fastened to the frame. Extending across both sides and the front, there are horizontal bars having brackets at the ends such as shown at *B*. Rods *C* are fastened in these horizontal bars and extend through holes in frame *A*. Brackets *B* have bearings on similar rods that extend downward from the frame. By loosening thumb-nuts, these horizontal bars can be lowered practically the full length of rods *C* and then reclamped. In this way the height of the guard can be varied widely.

Brackets *B* also have bearings in the horizontal plane to receive the shafts of gates such as indicated at *D*. These gates are provided on both sides of the die and at the front. They can be swung in or out to fit the die closely. Frame *A* is hinged at the left-hand side so that the entire guard can be readily opened to provide access to the dies.

While the illustration shows a guard set up for an operation in which strip stock is fed to the dies, the same guard design is used in many cases where the parts must be held in the die during the operation. In either case, the guard construction prevents the operator from placing his hand beneath the punch.



Punch Press Guard which is Adjustable in All Directions to Suit the Dimensions of the Die that Happens to be in Use

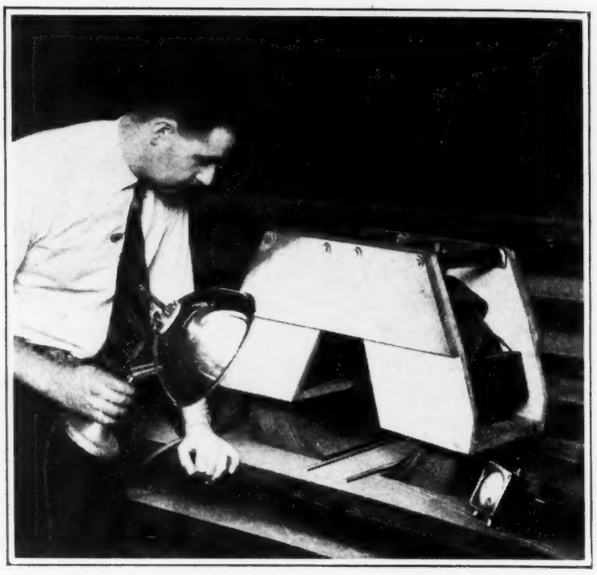
* * *

Recording the Time Machinery is in Operation

A new instrument, known as the Ohmer-Kienzle Seven-day Vibracorder, has been brought out by the Ohmer Fare Register Co., Dayton, Ohio. This instrument records the exact clock time that any piece of machinery is in operation or is idle. A small paper disk, 5 inches in diameter, taken from the instrument once a week, tells the whole story of seven days' operation. The instrument is operated by the vibrations or oscillations that are present in any piece of machinery when running. The instrument can also be applied to a motor vehicle. The Vibracorder resembles a small clock; it is, in fact, a high-grade eight-day clock with an easily read dial.

Magnetic Methods of Testing Welds

Faulty Welds Are Detected by New Magnetic Equipment with Surprising Accuracy and without Injury to the Members Being Tested



IMPROVED methods, developed at the Research Laboratories of the Westinghouse Electric & Mfg. Co., for applying non-destructive magnetic tests to butt welds were described in considerable detail in a paper presented by T. R. Watts before the meeting of the American Society for Testing Materials, Pittsburgh, Pa., held March 16 to 20. Two methods were described in this paper. One of these, known as the "magnetographic inspection," is the method most sensitive to poor fusion, cracks, or other faults which extend to or near the surface. However, this method is not fully satisfactory if relied upon alone, and unless applied on a level surface, its sensitivity is impaired by the usual rough reinforcing metal at the surface of the weld.

The other method, known as the "weld test meter method," will locate faults at practically any depth below the surface. It is less dependent on the experience and judgment of the user, and can be employed effectively for comparing welds made in the same kind of steel. For such work, the meter is calibrated by readings made on a test piece, which is afterward subjected to destructive tests. An instrument calibrated in this manner will indicate roughly the efficiency of a similar welded joint of the same material. In general use, variations in several factors encountered in shop practice prevent its readings from being closely correlated with strength, and it is merely a fault finder. It is therefore recommended that, whenever possible, both the magnetographic and the weld test meter methods be employed.

Principles and Application of the Magnetographic Method

The magnetic testing of welds is based on the fact that faults in welds increase their electric reluctance, and at flux densities of from 13,000 to 15,000 gausses, the difference between good and poor welds of a similar type and size is very easy to detect. Thus, the magnetic testing equipment consists essentially of some means of producing a magnetic flux through the steel, practically perpendicular to the welded seam, together with some means of detecting the regions of abnormally high reluctance.

In Fig. 1 is shown a small section of a magnetograph produced as shown in the heading illustration. The electromagnet for magnetizing the work has a horseshoe-shaped flexible laminated core with the laminations bolted together at the center only,

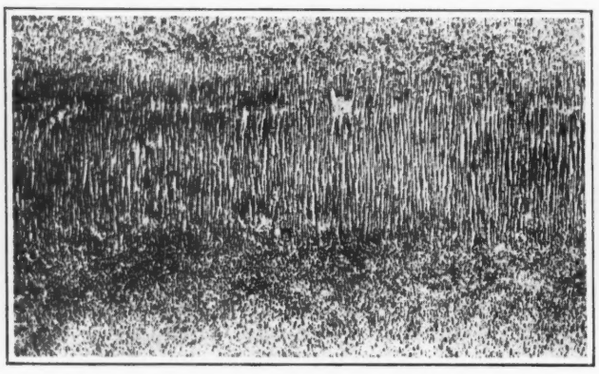


Fig. 1. Portion of a Magnetograph Showing a Good Butt Weld

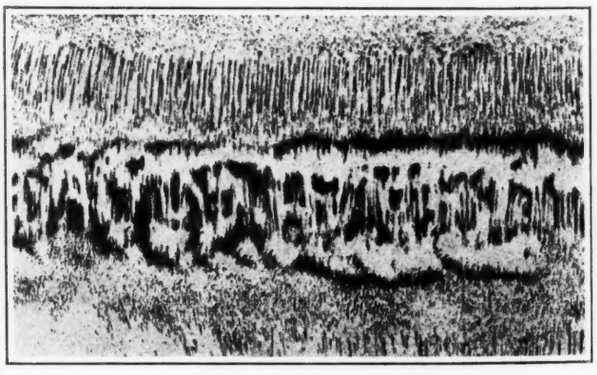


Fig. 2. Example of a Magnetograph Showing an Unsatisfactory Weld

so that the pole ends will pull down snugly against the surface to be tested.

The procedure in making the magnetograph is as follows: Iron filings or iron powder is sifted on the welded metal through which the magnetic flux is passed. A dense accumulation of the iron particles will form directly over any serious fault or poorly fused section, as indicated in the case of the magnetograph shown in Fig. 2. To make the filings easily visible, the weld is first painted white or covered with paper. If the flux density is low, the magnetographic picture may be brought out by lightly hammering the piece under test. When a permanent record of the test is desired, a piece of Van Dyke paper is placed on the weld and the iron powder sifted upon this paper, which is printed out, as shown in the heading illustration, by means of a simple twin arc lamp using therapeutic arc carbons. The Van Dyke paper is not affected by ordinary indoor illumination, but prints out readily under the light described.

The print thus made is simply washed, dried, and used as a film negative for as many photographic prints as desired. When convenient, the electromagnet is placed on the bottom surface of the piece being tested, where leakage flux from contact of the magnet with the piece is less likely to interfere with the magnetograph.

Magnetographic inspection, as mentioned, is relatively insensitive to faults far below the surface or to those obscured by the rough reinforcements at the top of the weld. Also, it is not sensitive to anything but serious faults unless applied on a horizontal surface. These disadvantages led to the development of the weld test meter.

Meter Method of Testing Welds

Magnetic testing of butt welds can be carried out with any instrument capable of measuring the leakage flux or magnetic potential drop between its terminals. The usual type of laboratory instrument, however, is unsuited for practical testing under shop conditions. For this reason, several meters were designed for shop use.

One of the types of instruments used is shown in the lower right-hand corner of the heading illustration. When this instrument is set against the surface of magnetized steel, the dial reading gives an approximate measure of the magnetic potential drop between the points on which its feet rest. The ratio of this reading across the weld to the readings on the parent metal on either side of the weld is a measure of the quality of the weld, since a bad weld will show a considerably higher ratio than a good one of the same type on the same materials.

As the leakage flux is greater and arches up higher over the bad weld, the test meter readings will show any difference between the weld on the test piece and the readings for a standard weld specimen that have been verified by a destructive test. Thus, faults can be readily detected by moving the test meter along the welded joint with the contact legs straddling the weld.

Welding High-speed Steel to Mild Steel

By M. L. ECKMAN, Research Engineer,
Federal Machine & Welder Co., Warren, Ohio

For welding high-speed steel to mild steel the following equipment is required: One flash welder, one lead pot at 1500 degrees F., one mica box. and flake mica. The high-speed steel is annealed for a distance of about 1 1/2 to 2 inches next to the point where the weld is to be made by heating it in the lead pot and placing it in the mica box to cool.

The mild steel shank is preheated to a dull red in the lead pot. This is done, first, because high-speed steel has greater electrical resistance than mild steel and, hence, will heat faster in the welding machine; and second, because when the mild steel is preheated, it will act as a reservoir of heat, preventing the chilling of the high-speed steel after welding. Now the two pieces of steel are placed in a resistance welding machine and welded. After being cooled, the tool is heated in the lead pot, 1 inch past the weld on the high-speed steel part, and is then cooled in the mica box. If this procedure is carefully followed, it will produce welds equal in strength to the original mild steel.

* * *

Convention of the National Metal Trades Association

The National Metal Trades Association will hold its thirty-third annual convention at the Hotel Sinton in Cincinnati, April 15 and 16. Among the subjects to be discussed will be stabilization of employment, unemployment insurance, employe training and development of supervisors, industrial research, the economics of business depressions, and what the machine has done for the wage worker.

Nationally known speakers will deal with these subjects, including Glenn Bowers, director of research, Industrial Relations Counselors, Inc.; James D. Craig, chief actuary, Metropolitan Life Insurance Co.; M. B. Folsom, assistant to the chairman, Eastman Kodak Co., Rochester, N. Y.; Magnus W. Alexander, president, National I..dustrial Conference Board; Harold S. Falk, vice-president and works manager, The Falk Corporation, Milwaukee, Wis.; and Franklyn Hobbs, director of research, Central Trust Co. of Illinois, Chicago. C. F. Kettering, in charge of development and experimental work for the General Motors Corporation, is expected to give the banquet address.

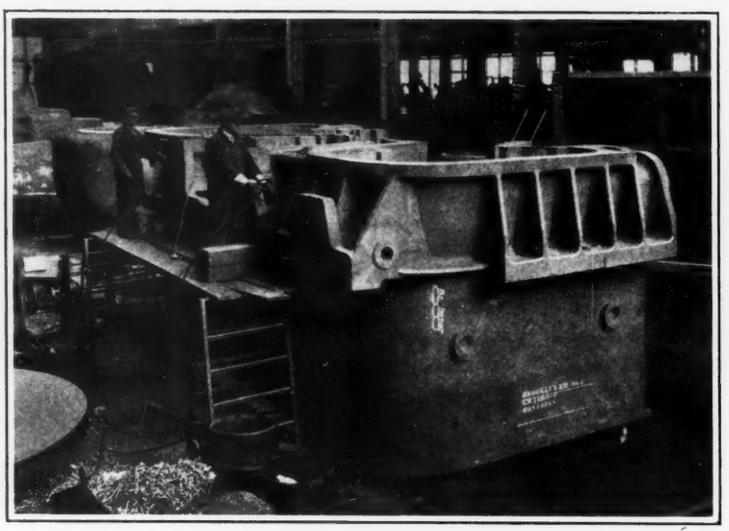
* * *

An interesting device for determining the value of lubricating oils and for ascertaining what oil will give the longest trouble-free service in gear-cases, is used in the Research Laboratories of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. A small electric light bulb is placed inside the gear-case, and through a thick plate glass, small particles contained in the oil, as well as gummy materials or metallic parts suspended in the lubricant, can easily be detected.

Present Practice in Making and Testing Welds

Considerable information on welding methods and methods of testing welds was brought out in a number of papers read before the meeting of the American Society for Testing Materials held at Pittsburgh, Pa., March 18. A paper entitled "General Survey of Welding Processes," by F. T. Llewellyn of the United States Steel Corporation, New York City, gave a complete classification of the principal welding processes and described their practical applications.

"Welding Processes Applicable to Aluminum" was the subject dealt with by W. M. Dunlap, metallurgist, Aluminum Research Laboratories, Aluminum Company of America, New Kensington, Pa. Mr. Dunlap described the application of oxy-hydrogen, oxy-acetylene, carbon arc, and metallic arc welding methods to aluminum. Tables were presented showing the mechanical properties of welded joints in aluminum.



The Lower Part of the Exhaust Hood for a 160,000-kilowatt Tandem Compound Steam Turbine Generator being Cleaned at the Schenectady Works of the General Electric Co.

A paper entitled "The Quality of Materials for Fusion Welding," by C. R. Texter and F. N. Speller, Department of Metallurgy and Research, National Tube Co., Pittsburgh, Pa., dealt with the selection of welding materials for different applications in constructional and manufacturing fields. Another paper entitled "Modern Applications of Arc Welding," by A. M. Candy, welding engineer, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., described the applications of this method of welding to the construction of electric generators and railway bridges. The use of automatic arc-welding machines for building up trolley car wheel flanges and similar work was also described.

The stethoscopic examination of welded products was dealt with by J. R. Dawson, metallurgical engineer, Union Carbide and Carbon Research Laboratories, Inc., Long Island City. This paper described the method of employing a stethoscope and hammer for testing welded manifolds and other types of work. A paper by T. R. Watts, Research Laboratories, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., described magnetic methods of testing butt welds. (See page 624 of this number of MACHINERY.)

T. M. Jasper, director of research, A. O. Smith Corporation, Milwaukee, Wis., presented a paper on "Fatigue and Impact Testing of Welded Products." The results obtained by fatigue and impact tests were illustrated by the use of charts and plotted curves. In a paper "Welding Inspection," by R. Kraus, Westinghouse Electric & Mfg. Co., the correct procedure in applying fillet welds by the electric arc was described and illustrated.

* * *

The World's Machinery Industry

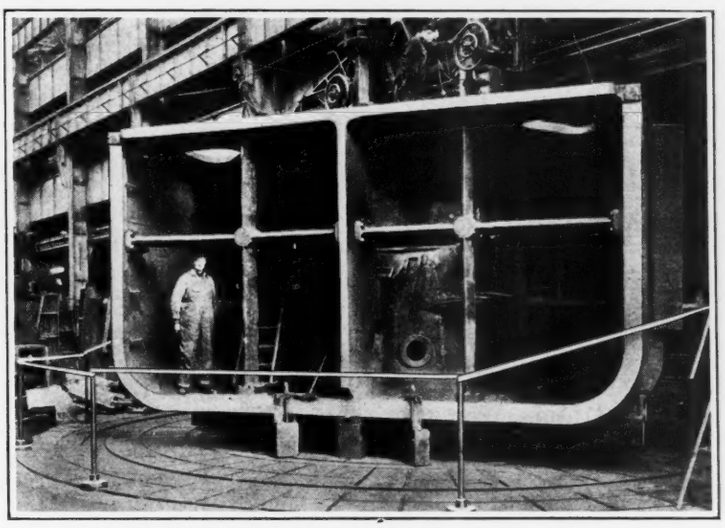
In his annual survey of the industrial machinery situation, W. H. Rastall, Chief of the Industrial Machinery Division of the Department of Commerce, states that the annual world consumption of machinery has now reached $5,500,000,000. Of this the United States accounts for $2,500,000,000. The annual per capita installation of machinery in the United States amounts to $23. This figure, for Great Britain, is $10, and for Germany, $9; for India it is only 17 cents and for China 5 cents. The machinery industry affords employment for about 500,000 men in the United States, and for about an equal number both in Great Britain and in Germany. About 250,000 men work in the machinery industry in Japan. The United States produces 57 per cent of the world's annual output of machinery; Great Britain and Germany each produce about 13 per cent.

Approximately $1,000,000,000 worth of machinery enters the international trade each year, of which the United States furnishes about 35 per cent, or $350,000,000. Of this amount industrial machinery—that is, machinery used in factories and mines, and for construction purposes—was exported from the United States in 1929 to a value of $257,000,000. Metal-working machinery accounted for $41,000,000. Since the war, Asia has absorbed machinery valued at $1,000,000,000 and Latin America $750,000,000 worth.

Hard-facing and its Practical Applications

In a paper read before the New York section of the American Welding Society, W. A. Wissler and A. V. Harris of the Union Carbide & Carbon Research Laboratories and of the Haynes-Stellite Co., respectively, called attention to a number of applications of hard-facing that indicate the remarkable results that may be obtained. Briefly, hard-facing is the process of covering a softer material, which may be susceptible to rapid wear, with a harder material that will resist abrasion to a greater extent.

The ordinary tail skids for airplanes are subject to a great deal of abrasive wear, particularly if the surface of the landing field consists of gravel or decomposed granite, as is often the case. On one landing field, the average life of ordinary skids was approximately 40 landings. These skids surfaced with Haynes Stellite were found to be good for 400 landings; and in one case when the skids were provided with tungsten-carbide insets, faced with Haynes Stellite, they lasted for 800 landings. The life was increased twenty times; the cost was increased only two and one-half times.



Machining the Lower Part of the Exhaust Hood for a 160,000-kilowatt Tandem Compound Steam Turbine Generator which is Shown on the Opposite Page being Cleaned

In cement mills, the surface of the steel rings against which the cement is crushed ordinarily lasts about 400 hours, whereas rings hard-faced with Stellite have lasted from 4000 to 7500 hours. While the life has thus been increased from ten to eighteen times, the cost is only increased about six times.

In the machinery industry, hot forming and trimming dies, when hard-surfaced at their points of wear, last much longer than ordinary steel dies. A hard-surfaced die for forming Ford brake pedals, for example, has produced thirteen times as many pieces as were produced by an ordinary die. Furthermore, after the hard-faced surfaces have worn down, it is possible to build up the worn part and put the die back into service. The hard-surfacing applications that have been mentioned give some idea as to the economy that may be obtained through this procedure.

Alvan T. Simonds on the Business Prospects

In the March 16 issue of *Looking Ahead*, published by Alvan T. Simonds, president of the Simonds Saw & Steel Co., Fitchburg, Mass., Mr. Simonds calls attention to the current practice of emphasizing misleading and discouraging comparisons of business activity. He points out that the discouragement of men engaged in business and industry has been increased due to "the hypnotic influence of the calendar year on business editors and writers," who, because of this influence, compare the early months of 1930 with the early months of 1931.

It is true that the volume of industrial production in February, 1931, was about 25 per cent lower than that of February, 1930. This, however, is not the important consideration at this time. What business managers need to be told now is that the bottom of the depression was doubtless reached in December, 1930, and that *since then there has been a slow rise.*

"Comparisons by calendar years of business, or of any months in one calendar year with the same months in the preceding calendar year are nearly always misleading," says Mr. Simonds.

Mr. Simonds, in conjunction with his assistant, John G. Thompson, also makes the following statement of extreme importance to all who are making plans for future business: "During the last fifty years, major swings in money rates have forecast accurately, months in advance, every major swing in business activity, that is, fourteen upward swings, including the boom of 1929, and fourteen downward swings, including the depression of 1930. Sales planning, production planning, and budgeting could have been based upon these forecasts without an error in the forecast in any instance."

* * *

Notwithstanding reduced operation in industry, the electrical power output in the United States for 1930 was only 2 per cent less than for 1929.

Proposed Standard for Rotating Air Cylinders and Adapters

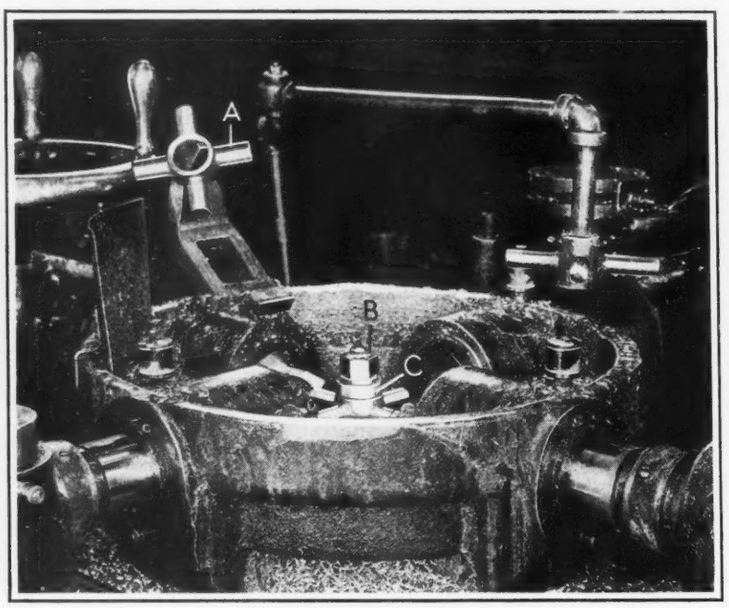
A proposed standard for rotating air cylinders and adapters has recently been completed by Technical Committee No. 11 on Chucks and Chuck Jaws of the Sectional Committee on Small Tools and Machine Tool Elements organized under the procedure of the American Standards Association. Those interested in this standard may obtain copies by applying to the American Society of Mechanical Engineers, 29 W. 39th St., New York City. Comments or criticisms are welcome.

The purpose of the standard is to obtain interchangeability between different makes of air cylinders on the spindles of machine tools without the necessity of changing the adapter or the draw-rod. In addition to the American Society of Mechanical Engineers, the National Machine Tool Builders Association and the Society of Automotive Engineers are cooperating in the preparation of this standard.

* * *

Machining Sixty Spiders per Hour on Four-way Drill .

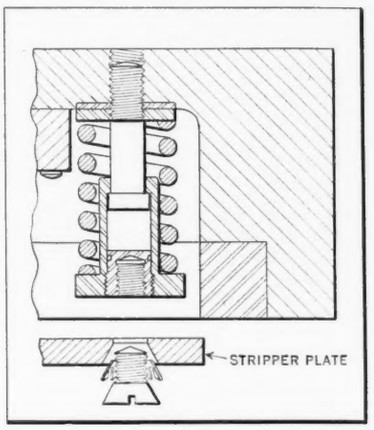
An efficient method is employed at the plant of the Hudson Motor Car Co., Detroit, Mich., for machining automobile spiders. All four arms of a spider, such as shown at *A*, are turned simultaneously on a four-way drilling and turning machine built by the Reed-Prentice Corporation, Worcester, Mass. The work- and tool-holding portions of the machine are shown in the accompanying illustration. The spider is clamped in position by nut *B* and slotted washer *C*. The production is sixty spiders per hour.



Four-way Drilling and Turning Machine Equipped for Turning Four Arms of Automobile Spider Simultaneously

Self-contained Spring Unit for Stripper Plates

To replace broken or worn parts in dies equipped with spring-actuated strippers, it is usually necessary to detach the stripper from its holder. Nearly all strippers of this type are designed so that the heads of their retaining screws slide in counterbored holes at the back of the punch or die holders. Consequently, to detach the stripper from the holder, the latter must be removed from the press. This, however, is unnecessary with the arrangement shown in the illustration. The device used consists of a coil spring and a fillister-head screw provided with a sleeve to which the stripper is attached by a flat-head screw. This device is known as "Strippits," and is made by S. B. Whistler & Sons, Inc., Buffalo, N. Y.



Device that Enables Stripper Plate to be Removed without Disturbing Die

It is obvious that by removing the flat-head screws the stripper is released and can be slipped from the die without disturbing the set-up. Another advantage is that the thickness of the holders can be substantially decreased, as no extra depth is required for counterbored holes to accommodate the heads of retaining screws.

When a great number of springs are required to produce the desired pressure, only four of the sleeves on the screws need be fastened to the stripper, the remaining sleeves merely resting against the stripper. These "Strippits" are furnished in several sizes, with initial pressures ranging from 175 to 250 pounds, and a maximum travel of the sleeves of 1/2 inch to 1 1/2 inches.

* * *

Abrasive Wheel Applied to Cut-off Machine

Solid bars up to 2 inches in diameter can be cut off by means of a 16-inch abrasive wheel that may be applied to the No. 6 cut-off machine built by the Hunter Saw & Machine Co., 57th and Butler Sts., Pittsburgh, Pa. This abrasive wheel merely replaces the standard 18-inch saw used for cutting light sections, structural angles, and pipe. A new guard has also been devised to house the wheel and driving mechanism more fully and thus provide greater safety for the operator.

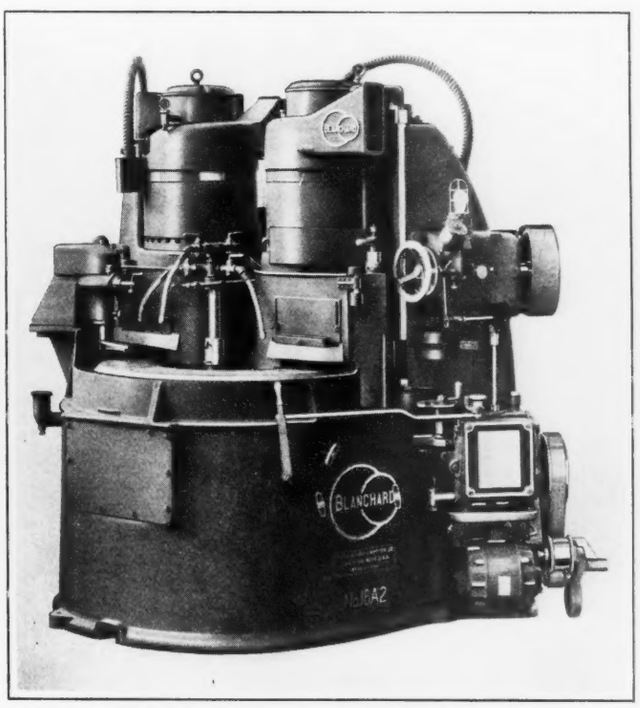
New Shop Equipment

Latest Developments in Metal-working Machines, Small Tools and Work Handling Appliances

Blanchard Automatic Surface Grinder with Two Abrasive Wheels

Work is rough- and finish-ground successively in an automatic surface grinding machine provided with two grinding wheels, which has recently been developed by the Blanchard Machine Co., 64 State St., Cambridge, Mass. Each of these wheels is maintained at a fixed height by an individual control caliper. This caliper gages the pieces as they leave the wheel and causes the wheel feed to operate as required in order to maintain the specified work size within close limits. The operator places the work pieces on the continuously revolving table or chuck, which carries them beneath the grinding wheels and the control calipers, as well as through a demagnetizer and washer, if desired. The pieces of work are then unloaded automatically.

The independent control calipers make it possible to control not only the finished size of the work, but also the amount of stock left for removal by the second or finishing wheel. Having determined the proper amount of stock to be removed by the second wheel, the caliper of the first wheel is set to so control the height of this wheel that only the desired amount of stock is left on the work, regardless of initial variations in the rough pieces. The caliper of the second wheel is, of course, set to the finished size of work, and will control that wheel to deliver the finished pieces with uniform thickness.



Blanchard Automatic Surface Grinder with Two Wheels for Rough- and Finish-grinding Successively

One of the wheel-control calipers can be seen at the left in the illustration at the top of this page, adjacent to the left-hand wheel-head. It consists of a vertical spindle mounted in ball bearings. An arm at the lower end of the spindle holds a shoe or contact member with its lower surface parallel to the table. At the upper end, the spindle carries an arm of insulating material which holds a small copper disk. A slight turn of the spindle will bring this copper disk against two contacts, thus connecting them

and allowing current to flow to a magnetic coil on the feed mechanism. The caliper spindle and its bearings are contained in a sleeve which is adjustable by means of the crank-handle. One turn of this crank moves the spindle up or down 0.005 inch, and graduations to 0.0001 inch make finer adjustments easy.

With the caliper shoe and grinding wheel at the same height above the table, a piece of work ground by the wheel will touch the caliper shoe as it passes under it. However, the friction against the shoe will not be sufficient to move it. As the wheel wears, the work pieces will gradually increase in thickness, and an increase of between 0.0001 and 0.0002 inch will result in sufficient pressure against the shoe to move it. This will cause the caliper spindle to turn in its ball bearings against the resistance of a light spring. This motion closes the contact and causes the magnet to lift a locking pin and allow a feed pawl to operate. A crank which drives this pawl runs continuously.

As soon as the grinding wheel is moved downward sufficiently to produce work of the thickness for which the caliper is set, the caliper spindle turns back to its original position. Since the wheel feed is absolutely locked, except when the work is slightly too thick, there is no chance of grinding pieces under size. As the control is governed by the actual gaging of ground work, it is not affected by varying rates of wheel wear, whether due to inequalities of hardness in the wheel or variations in the thickness of the work.

The base of the machine serves as a tank for the coolant. Mounted on the base is a circular casting which contains bearing surfaces for the rotary table or chuck. Adjacent to this casting are two columns, each of which carries a wheel-head positioned over the working surface of the table.

The work-holding surface of the table or chuck is 40 inches outside diameter and 26 inches inside diameter. Work to be ground must lie between the 26-inch circle and a 43-inch circle, which is the outer clearance limit. There is an independent feed mechanism for each wheel-head, with a power feed motion controlled by the wheel caliper for that head. The gear-box, which provides four table speeds and has a clutch for starting and stopping, is mounted on the base and driven by a two-horsepower motor. Two water pumps, driven direct by 3/4-horsepower motors, are mounted in the rear of the base tank. Electrically controlled apparatus for the seven motors of the machine is mounted on a separate panel which stands on the floor and is operated by means of push-buttons on the machine.

For work that can be chucked magnetically, a magnetic chuck of the single-pass type is used. A rheostat provides for reducing the magnetic holding force during the finish-grinding while full magnetism is being used on the work being rough-ground. Several types of fixtures are available for work that must be clamped mechanically. These fixtures range from full automatic designs to simple hand-clamped types.

The over-all dimensions of the machine are 7 feet 5 inches long, 7 feet 3 inches wide, and 8 feet 1 inch high. The net weight, without water in the tank, is approximately 17,500 pounds. The motor equipment includes two 30-horsepower, or smaller, motors on the wheel-spindles; a two-horsepower motor for driving the work-table; two two-horsepower motors for raising and lowering the wheel-heads; and two 3/4-horsepower motors direct-connected to the pumps.

New Britain Automatic Bar Machine

The No. 38 New Britain single-spindle automatic chucking machine built by the New Britain-Gridley Machine Co., New Britain, Conn., has been slightly redesigned to convert it into a bar machine that will take stock up to 5 inches in diameter. The same basic machine, therefore, is now available either for chucking or bar work. In addition, the makers are prepared to furnish extra parts required for converting the chucking machine into a bar machine or vice versa, or for adapting a chucking machine now in use for bar work.

A detailed description of the chucking machine was published in February, 1928, MACHINERY, pages 476 and 477, under the title "Gridley Automatic Chucking Machine." The new bar machine is practically identical with the chucking machine, and has interchangeable parts, except for

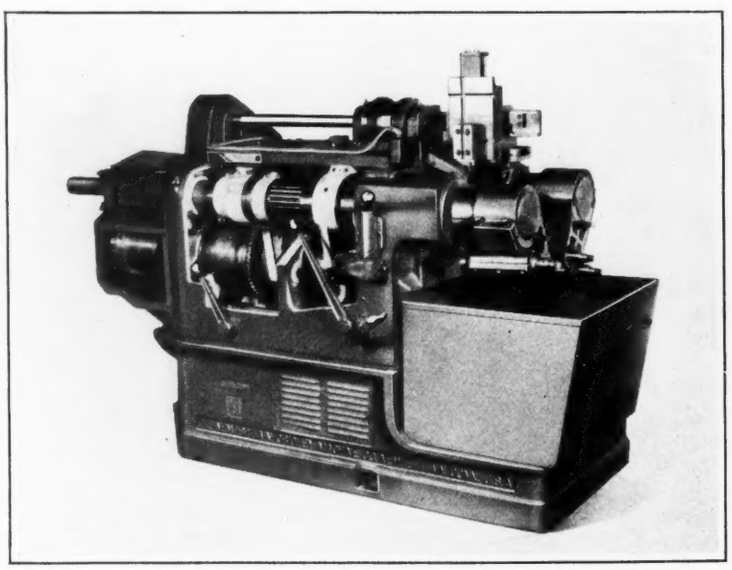


Fig. 1. New Britain Single-spindle Automatic Bar Machine

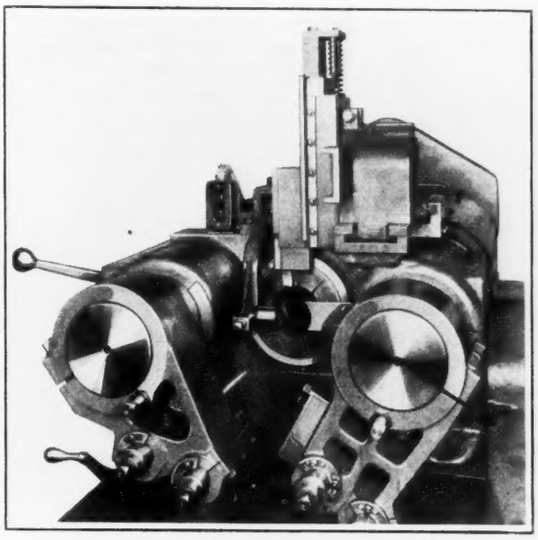
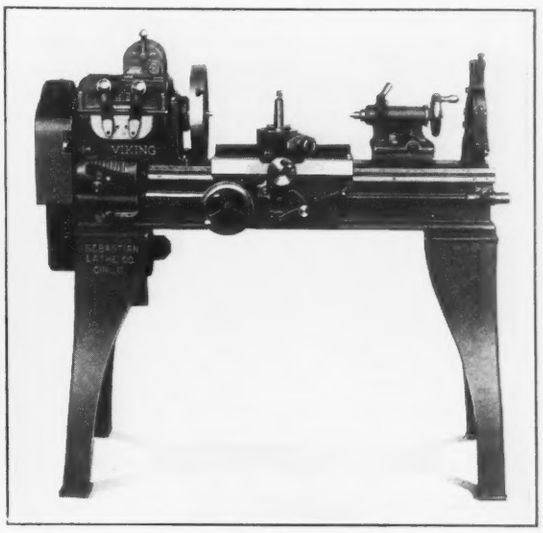


Fig. 2. View Showing Ends of Tool-slides and Work-spindle of Automatic Bar Machine



Viking Motor-driven Geared-head Lathe, which is Built in 12-, 16-, and 20-inch Sizes

the hollow spindle required on the bar machine, the bar feeding mechanism which is mounted in a separate housing bolted to the rear end of the machine, an adjustable stop for the stock, and a few other minor parts.

Unusually heavy ball bearings in the spindle construction, for a machine of this capacity, constitute one of the important features of the new machine. Another feature is the collet locking mechanism which operates on a new principle involving the use of a large number of balls to obtain the required pressure for locking. The construction makes it possible to obtain a definite locking pressure that is perfectly balanced, and assures long life of the mechanism.

The hydraulic unit that was used for operating the chuck in the chucking machine is removed in the bar machine. The pressure pump, however, is retained, and is used for obtaining flood lubrication for the entire machine. In the chucking machine as now built, there is also a change from the design illustrated in connection with the description previously published, in that the entire hydraulic unit is enclosed within the machine frame instead of being a separate mechanism placed at the rear of the machine. In the bar machine, the centrifugal pump for the cutting compound is driven directly by a motor. It has a capacity for delivering 70 gallons of cutting compound per minute.

It will be recalled from the description previously published, that there are two tool-holders moved longitudinally by slotted drum cams and fed into the work by a radial cam mechanism, the maximum longitudinal movement being 4 inches. If required, a third tool-holder can be fitted above the work. On the bar machine, the pusher which advances the bar and the work-holding chuck are operated mechanically by the mechanism added to the rear end of the machine.

Practically all parts of the machine except the frame and the tool-holders are forgings or parts machined from bar stock. The rigidity of the machine contributes to the accuracy of the work performed in it, as does also the use of exceptionally large preloaded ball bearings on all shafts, including the camshafts. It is stated that the production rates are limited only by the maximum allowable cutting speeds of the tools used. These speeds can be varied as desired by changing the sprockets on the main drive.

The total weight of the bar machine is 8300 pounds. It requires a floor space 36 inches wide by 84 inches long.

Viking Motor-driven Geared-head Lathe

Motor-driven geared-head lathes of the design illustrated are being introduced on the market in 12-, 16-, and 20-inch sizes by the Sebastian Lathe Co., Cincinnati, Ohio. The lathes of this line have been given the trade name of Viking and are intended for use in both manufacturing plants and vocational schools. The design is similar to that of the Gold Seal lathe manufactured by the company, but has been simplified so that a much lower price has been made possible.

Eight spindle speeds, ranging from 26 to 620 revolutions per minute, are available through the geared headstock. Threads from 6 to 96 per inch can be cut by means of feeds provided through the quick-change gearbox. There is a power feed for the cross-slide.

Bunting Low-friction Bushings and Bearings

Bushings and bearings made of new super-hard low-friction bronze alloys are being placed on the market by the Bunting Brass & Bronze Co., Toledo, Ohio. These bearings have been developed primarily for applications where hardness and the

ability to withstand pounding are essential, together with low friction and minimum wear. The lead content in these bearings can be varied from 5 to 25 per cent, depending upon the type of service for which the bearings are intended.

Toledo Improved Heavy-duty Presses

A series of improved heavy-duty presses has just been placed on the market by the Toledo Machine & Tool Co., Toledo, Ohio, for many kinds of bottoming work, such as restriking brake-drums; sizing emergency brake levers, connections and similar parts so as to eliminate the necessity of straddle-milling; embossing articles of large dimensions; and both cold- and hot-forging operations. One of these presses is shown in the accompanying illustration.

The base, uprights, crown, and forged-steel tie-rods of these machines are all unusually heavy. The tie-rods at the back of the frame help to take the reaction of the blow, and a heavy knock-out bar near the center of the frame still further increases the rigidity. An idea of the size of the machine illustrated may be obtained from the fact that the bed measures 60 inches from front to back and 43 inches from right to left. The distance from the floor to the top of the bed is 18 inches, and although the press weighs about 250,000 pounds, its height above the floor is only 14 1/2 feet. It will be understood, however, that a large part of the bed is below the floor line.

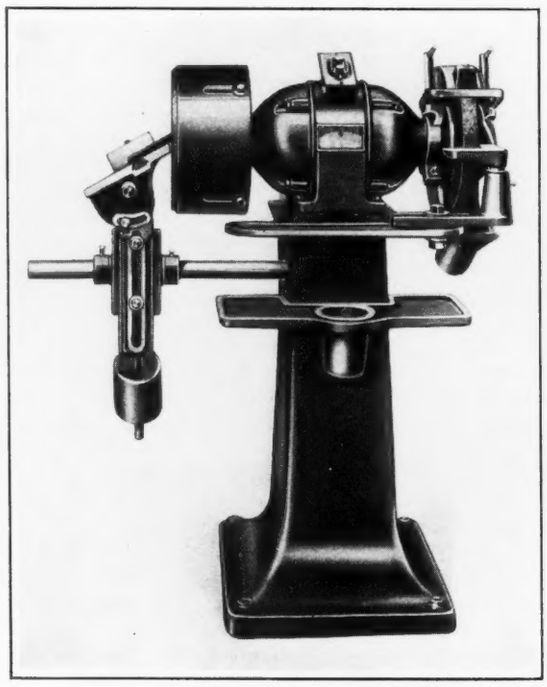
The crankshaft is of the full eccentric type. It has a stroke of 12 inches and is capable of exerting a pressure of 1500 tons at the bottom. The twin gears used are sufficiently large to take the full load of the press at any point of the stroke. The connection screw provides an adjustment of 3 inches. The distance from the top of the bed to the slide, with the stroke down and the adjustment up, is 24 inches.

The press is driven by a 50-horsepower motor running at about 1200 revolutions per minute, the ram operating at 30 strokes per minute. The operation of the press is controlled by a multiple-disk friction clutch which is integral with the flywheel. An independent brake permits of stopping or starting the press at any part of the stroke.

Grinder for Tungsten-carbide and High-speed Steel Tools

A grinder intended especially for sharpening tungsten-carbide and high-speed steel tools has been developed by the United States Electrical Tool Co., 2477 W. 6th St., Cincinnati, Ohio. One tool-rest of this machine comprises an adjustable table and a sliding guide. These hold the tool securely against the cup-wheel at any desired angle and prevent the grinding away of more stock from the tool than is necessary to sharpen it. Longer tool life and lower tool costs are thus obtainable. The table is conveniently set to any angle by using the protractor. This tool-

Toledo Heavy-duty Press Intended for Sizing, Embossing, and Other Operations



Grinder Designed for Sharpening Tungsten-carbide and High-speed Steel Tools

rest is also adjustable for height and for wheel wear.

The 2-horsepower motor which drives this grinder runs at 1750 revolutions per minute and can be furnished for any standard voltage of alternating or direct current. In addition to the model shown in the illustration, this grinder can be supplied with a cup-wheel and a swinging table on both ends.

Brown & Sharpe Manufacturing Type Milling Machine

A No. 22 plain milling machine of the manufacturing type has been added to the line of machine tools produced by the Brown & Sharpe Mfg. Co., Providence, R. I. This machine possesses features which adapt it for both short- and long-run production jobs. It has an automatic longitudinal feed of 22 inches, a transverse saddle adjustment of 6 inches, and a vertical spindle-head adjustment of 13 inches.

All operating functions are controlled from the front of the machine. Speed changes, feed changes, hand longitudinal adjustment of the table, transverse adjustment of the saddle, as well as vertical adjustment of the spindle head are accomplished through a single lever. The spindle head is clamped by a lever convenient to the operating position. Automatic control of the table is obtained through dogs which are adjustable along the front of the table. A hand table control is also furnished. Table power fast travel and feeds are available in both directions.

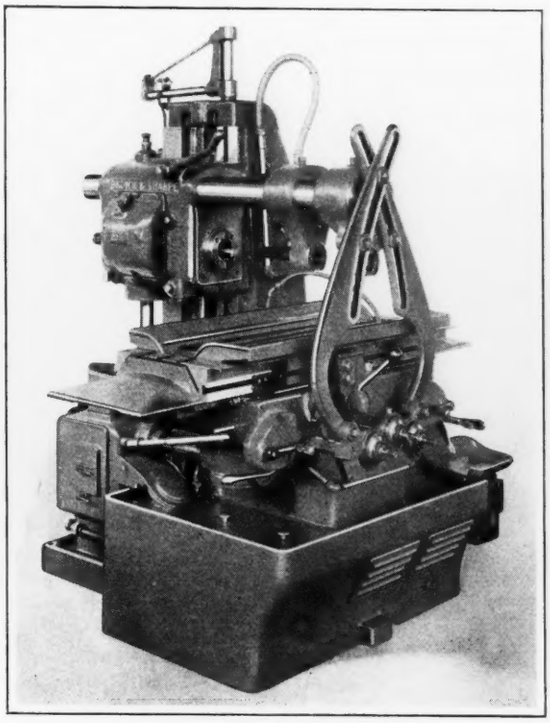
The spindle is mounted in four anti-friction bearings and can be rotated right- or left-hand. It can also be made to rotate continuously or to stop simultaneously with the engagement of the table fast travel, and start again with the engagement of a cutting feed. Automatic lubrication is provided for all units in the base and for the driving unit.

The speed- and feed-change system is the same as that used on Brown & Sharpe standard milling machines. Sixteen spindle speeds ranging from 25 to 620 revolutions per minute, and sixteen feeds ranging from 1 to 38 1/2 inches per minute are available. Direct-reading dials indicate the speed or feed for which the machine is set. Feed changes are made by means of a lever on the left side of the saddle and speed changes by a lever on the right.

A vertical milling attachment, a crane for this attachment, and a fixture flushing pump can be provided. The machine is built with a pad on the back of the column to which the vertical milling attachment can be fastened when not in use. The crane provides a convenient means of transferring the attachment to the face of the spindle head.

Gleason Gear-generator Tool Sharpener

Tools used on the straight bevel-gear generators and on the 60-inch spiral bevel-gear planing generator built by the Gleason



Brown & Sharpe Milling Machine Designed for Short- or Long-run Production Work

Fig. 1. Gleason Grinder for the Tools of Straight Bevel-gear and Spiral Bevel-gear Generators

Works, 1000 University Ave., Rochester, N. Y., may be sharpened on the grinder illustrated in Fig. 1, which has been added to the line of equipment made by this concern. Only one grinding wheel is employed on this machine to sharpen the tools used for cutting the opposite sides of the gear teeth. The only rotating parts are the wheel-spindle and the pump. These are driven by a belt connected to the motor.

The tools are mounted in pivoted holders in the manner shown in Fig. 2. To sharpen them, they are simply moved across the edge of the grinding wheel by hand. Feeding in to the wheel is effected by means of the handwheel on top of the bracket to which the tool-holders are attached. The grinding is always done against the cutting edge of the tools, thus reducing the possibility of burning this edge and also preventing the production of a burred edge.

Tools can be ground to any side-rake angle by loosening a nut on the tool-holder and turning the tool to the desired angle, as indicated by the collar. The desired front-rake angle can be obtained by making a similar setting at the point where the tool-holder is attached to the bracket. A standard 7- by 2- by 1 1/4-inch cup-wheel is used. This machine occupies a floor space of 32 by 36 inches and weighs 1500 pounds.

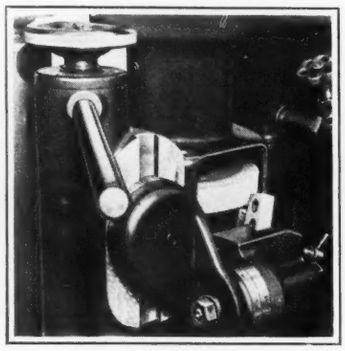
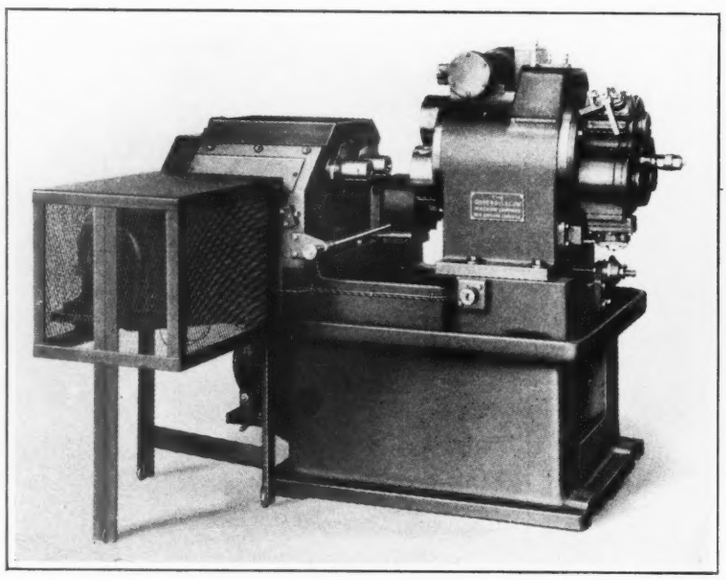


Fig. 2. Applying a Generator Tool to the Grinding Wheel

Goss & De Leeuw Two-spindle Automatic Chucking Machine

Boring, facing, turning, drilling, reaming, and threading operations can be performed in various combinations in a two-spindle machine recently added to the line of chucking machines built by the Goss & De Leeuw Machine Co., New Britain, Conn.



Goss & De Leeuw Two-spindle Machine for Handling Simple Jobs on an Automatic Basis

This machine has been designed primarily for handling comparatively simple chucking jobs on an automatic basis.

Two horizontal spindles positioned side by side revolve the cutting tools. Opposite them, on a faceplate, are three work-holding chucks. Two of these chucks simultaneously present work to the tools while the third, in the upper position, is being reloaded. By indexing the faceplate, the work is carried successively from the loading position to the first spindle in the rear, then to the second spindle in front, and finally back to the loading position.

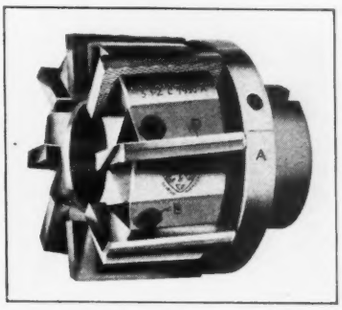
The finished piece can be ejected automatically from the air chuck as it passes from the second position to the reloading position. In loading, the operator merely places a rough piece in the open chuck and trips the closing valve. All three mechanisms for indexing, feeding, and withdrawing the tools, and for starting, reversing, and stopping the threading spindle are automatically operated and mechanically interlocked.

The distance between the chuck centers is 7 inches, which, together with the ample clearance available while indexing, permits the handling of large and irregularly shaped pieces. Production cycles of from 180 to 1200 per hour are obtainable with standard sets of feed pick-off gears. The spindle speeds range from 100 to 1000 revolutions per minute for either threading or plain machining. The threading spindle is driven and reversed by means of the standard Goss & De Leeuw independent reversing motor unit.

In designing this machine, special attention was paid to providing means for quickly changing over from one set-up to another. The feed cycle and individual spindle speeds are adjusted by means of quick-change, pick-off gears. The cam is seldom changed, but when this is necessary, it takes only about ten minutes. All threading tools are controlled by lead-screws in constant engagement with their nuts. The machine can be readi-

ly arranged for cutting two threads of different pitches and diameters simultaneously in the same spindle.

A pressure of 2100 pounds is obtained on the jaws of the air chucks with an air pressure of 60 pounds per square inch. The maximum opening of the jaws is unusually large for air chucks, and hand-operated two-jaw chucks are furnished for work pieces requiring larger openings. Power for indexing the faceplate is furnished by an air cylinder on top of the turret. An unexpected cutting off of the air supply will not cause tool breakage because of failure to index, nor will it result in the loosening of work in the chucks.



Goddard & Goddard Serrated-blade Expansion Finishing Reamer

Goddard & Goddard Serrated-blade Reamers

Quick adjustment, positive positioning, and unusually long blade life are advantages claimed for the serrated-blade expansion finishing reamer here illustrated, which has been added to the line of flat wedge-type reamers made by the Goddard & Goddard Co., Inc., Detroit, Mich., which were described in the July, 1930, number of MACHINERY. The new reamers consist of four component parts, including a heat-treated alloy steel body, high-speed steel or other blades, an adjusting nut, and a cam lock.

In making an adjustment, a set-screw in adjusting nut *A* is loosened and this nut is revolved backward one full turn. Then blade cam lock *B* is released by turning it 90 degrees to the right. Blades *D* are next slid back against the adjusting nut, after which the nut is turned against the blades until the desired reamer size has been established. Finally, the cams are locked with a 90-degree turn clockwise, and the set-screw in the adjusting nut is retightened.

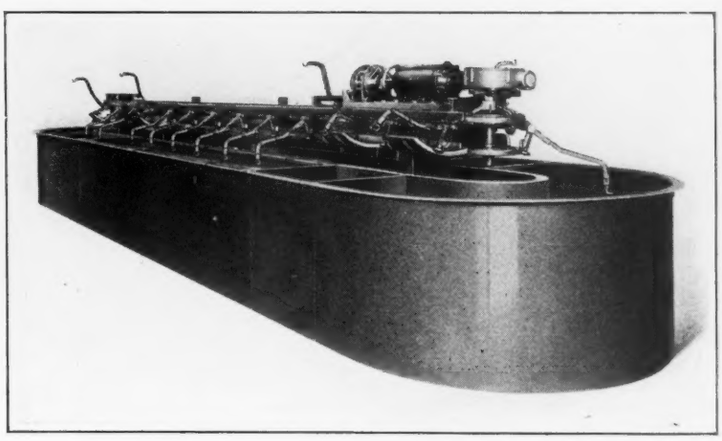
The blades are adjusted toward the shank for expansion, the blade slots being deepest at the reamer end. As this longitudinal movement is only slightly more than 3/16 inch before a blade is moved outward radially to the next serration and forward again to the initial position, the blades are always held firmly in large-area contact with the body. The blades register at all times in the serrations, and as they do not contact with the bottom of the slots, any blade can be replaced without affecting the remaining blades.

Long blade life is insured by the amount of adjustment provided. One-inch reamers may be expanded 0.187 inch; 2-inch reamers, 0.250 inch; 3-inch reamers, 0.442 inch; and reamers 4 1/2 inches and over, 0.625 inch. Only eight blade sizes are required for the entire standard finishing reamer range of from 1 to 6 inches. Three standard styles of these reamers are available—shell, taper, and straight-shank.

Stevens Return-type Full-automatic Plating Machine

An automatic plating machine without overhead construction has been recently developed by Frederic B. Stevens, Inc., Larned and 3rd Sts., Detroit, Mich., for all kinds of electroplating and cleaning. The illustration shows one of these machines which was recently installed in the Mansfield, Ohio, plant of the Westinghouse Electric & Mfg. Co. All of the moving parts, including the conveyor chain, transfer units, carrier arms, and driving unit, are supported by a structural steel member at the middle of the equipment. The various solution tanks are shown grouped around the mechanism.

The raising and lowering transfer units are attached to steel channels which run the length of the machine. As the carrier arms fastened to the conveyor chain travel around the machine and reach one of these transfer units, they are raised to lift the work out of one tank, and after passing the end of the tank in the raised position, are lowered to immerse the work in the solution of the next tank. When the work is lowered into a plating tank or any tank where electrical current is required, an electrical contact is made. This contact is broken when the work is raised from the tank.



Full-automatic Electroplating Machine Recently Built by Frederic B. Stevens, Inc.

One of the important advantages claimed is that this equipment is especially adapted to chromium-plating. It is pointed out that to properly chromium-plate irregularly shaped pieces, and particularly pieces having depressions, special anodes must be used to direct the current into these depressions. In the full-automatic plating machine here described, the carrier arms are equipped with both anodic and cathodic contacts, so that both the specially designed anodes and the work are carried on the same carrier arm. Tanks requiring ventilation can readily be equipped with side exhaust hoods for carrying off fumes.

Norton Hydraulic Surface Grinding Machine

A hydraulic surface grinding machine intended for both general tool-room and production work has recently been developed by the Norton Co., Worcester, Mass. As will be seen in the illustration, the controls of this machine are closely grouped. Centralized lubrication is provided for all important bearings.

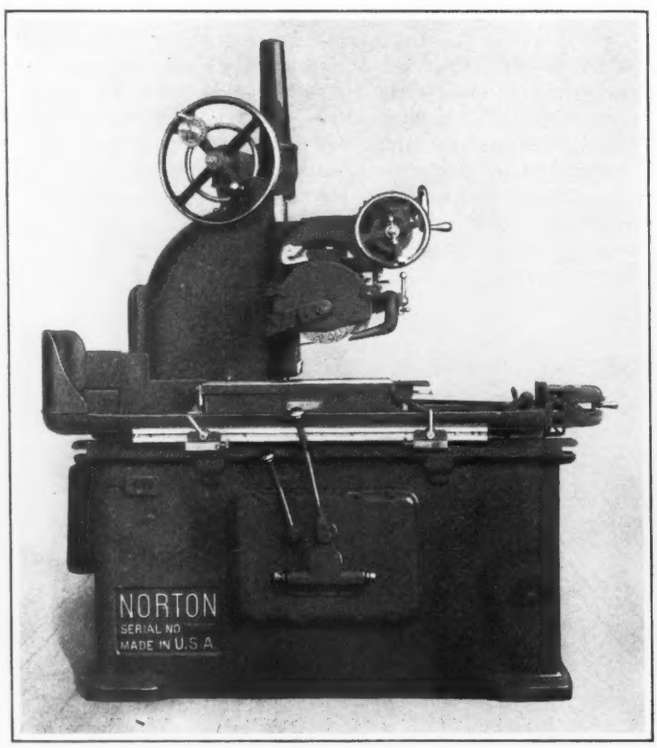
The machine is driven by a single 7 1/2-horsepower motor located in the base. The table reciprocation is operated hydraulically. The wheel feed is hand-controlled and graduated for movements of 0.00025 inch. The wheel traverse is also hand-operated, there being one speed for grinding and another for truing. In addition to the hand traverse, the wheel may be traversed hydraulically. The wheel-spindle is mounted in ball bearings and has been found especially suitable for work with an interrupted surface.

Without a magnetic chuck, the machine has a capacity for work up to 10 inches wide by 12 inches high by 24 inches long. With a chuck, the height capacity is reduced to 9 1/4 inches. The machine requires a floor space of approximately 5 by 8 feet, and weighs 5500 pounds.

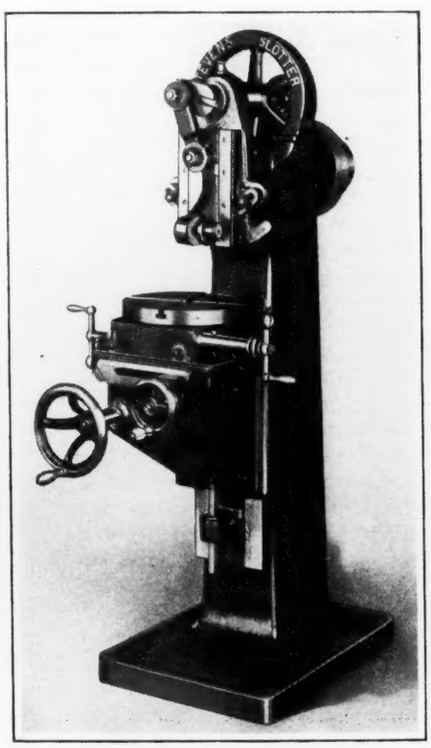
Stevens Vertical Slotter

A machine adapted to die work, keyseating (both straight and tapered), the making of internal and external gear patterns requiring draft, and vertical slotting has been placed on the market by John B. Stevens, Inc., 304 Hudson St., New York City. Longitudinal and cross motions, in combination with the rotary table, provide for cutting to any outline.

The worm-shaft of the rotary table is arranged with a dial graduated to read in minutes. For small divisions and rapid work, the table can be revolved by hand. A lock-pin provides twelve accurate divisions, including the divisions required for squares, hexagons, and octagons. Micrometer dials are supplied on the screws through which the longitudinal, cross, and vertical movements of the machine are obtained. The cutting tools may be clamped in either of two positions. The design of the machine is such as to make it suitable for both tool-room use and general manufacturing.



Norton Hydraulic Surface Grinding Machine for Tool-room or Production Work



Stevens Vertical Slotter for Making Dies and Doing Similar Work

The ram stroke is adjustable from 0 to 4 inches, and three different ram speeds are available. The ram slide can be swiveled up to 5 degrees either to the right or left of the central position and set to an index reading in degrees. A motor drive can be provided.

Other important specifications are as follows: Diameter of circular table, 12 inches; vertical adjustment of table, 11 1/2 inches; adjustment in line with spindle, 5 1/2 inches; adjustment across line of spindle, 7 inches; distance from column face to tool center, 9 1/4 inches; and floor space required, 28 by 44 inches.

Gisholt Improved Tool Grinder

Several improvements have been made recently in the universal tool grinder built by the Gisholt Machine Co., 1209 E. Washington Ave., Madison, Wis., to adapt this machine for sharpening tungsten-carbide tools without sacrificing its efficiency on high-speed steels. Since the nature of tungsten-carbide tools necessitates a light even pressure against the grinding wheel, the spindle has been redesigned to incorporate a spring-cushion ball thrust bearing. Excessive pressure cannot be exerted against the face of the cup-wheel, as the wheel is held against the tool by spring pressure only. In grinding tools other than tungsten carbide, this cushioning device may be locked to permit the taking of heavy cuts.

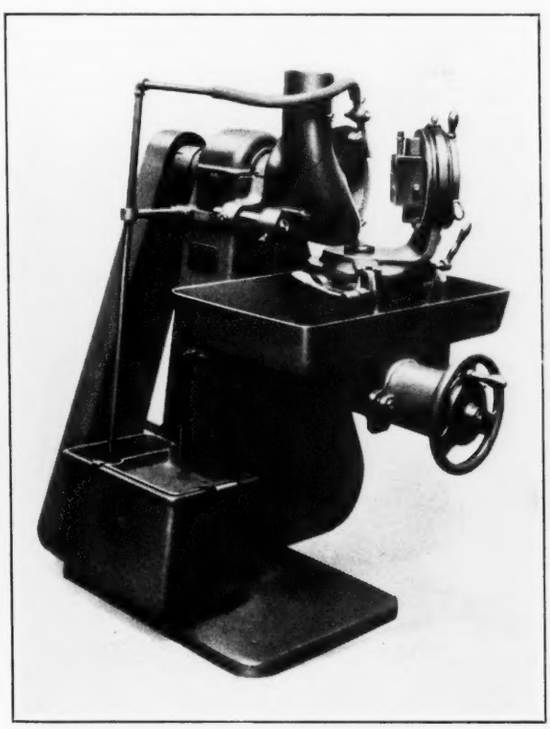
The design of the wheel mount is such that wheels may be rapidly changed to suit different materials. The wheel end of the spindle is of the labyrinth type to protect the bearings from tungsten-carbide dust. Oil gages have been added to both the front and rear bearings.

The wheel guard is of much heavier construction than before, and may be directly connected to overhead dust collection systems. This grinder is primarily intended for sharpening single-point cutting tools of either the inserted-cutter or solid forged type, for use on turret lathes, engine lathes, shapers, planers, slotters, boring mills, etc.

Airplane Propeller Balancing Stand and Inspection Equipment

A stand for balancing airplane propellers is illustrated in Fig. 1, and blade inspection equipment is shown in Fig. 2. They are recent developments of the Steel Products Engineering Co., Springfield, Ohio. For balancing, the propeller is slipped on arbor *A*, Fig. 1, and tightened by means of lock-nut *B*. The ways on which the arbor rolls are leveled by means of adjusting nuts *C*. Balance weights *D* are graduated in inch-pounds to show directly the amount of stock to be removed from the propeller for obtaining a balanced condition.

The inspection equipment in Fig. 2 is used by placing the hub



Gisholt Tool Grinder Adapted for Grinding Tungsten-carbide Tools

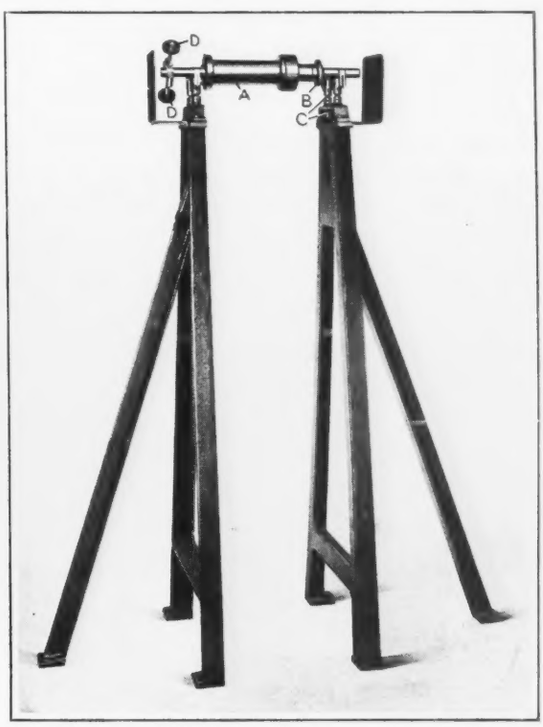


Fig. 1. Stand Designed to Facilitate Balancing Airplane Propellers

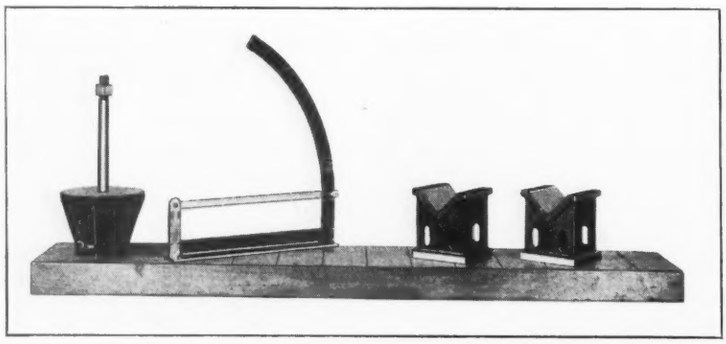


Fig. 2. Inspection Equipment which Indicates the Angles of Airplane Propeller Blades

of a propeller on the flange at the extreme left, adapters being employed for different hub sizes. The protractor, together with the necessary templets and lines scribed transversely on the base, provides means of determining the angle of the propeller blade accurately at points that may be selected.

Fellows Gear Shapers for Gears Integral with Shanks

A new line of gear shapers known as the 64A type has been recently placed on the market by the Fellows Gear Shaper Co., Springfield, Vt. These machines are fundamentally of the same construction as the standard 6A and 6A-3 types described in MACHINERY for August, 1930, page 992, and December, 1928, page 300. However, there is a new apron of heavier design to accommodate a large work-spindle which permits the cutting of gears integral with shanks. As will be seen in the illustration, the work-spindle has a straight hole 5 7/8 inches in diameter passing completely through it. It can be arranged with sleeves to hold shank gears having a maximum shaft diameter of 5 inches or with an adapter to fit standard reverse-taper work-arbors.

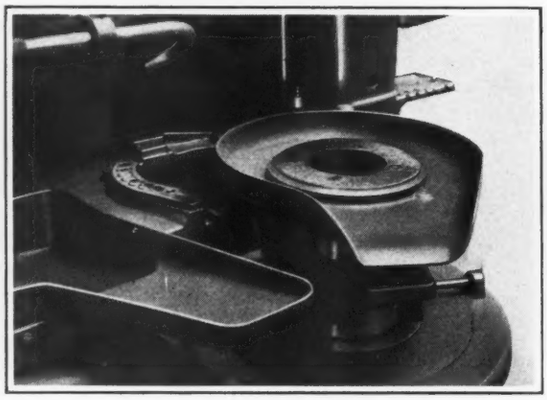
In addition to the apron, other new features include a hardened and ground plate on the base for the apron bearing, and grease pressure cup lubrication for the apron, work-spindle, apron bearing angle-block, and apron pivots.

The Nos. 64A and 624A machines have capacities for 18-inch external spur gears, 5 inches in face width, and 18-inch internal gears, 3 inches in face width. The No. 64A machine is adapted to use both 3- and 4-inch pitch diameter cutters with a 1 1/4-inch hole, whereas the No. 624A machine can only use 4-inch cutters with a 1 3/4-inch hole. The capacities of the No. 645A machine are the same, but this machine is adapted to cutting helical and herringbone gears, in addition to the spur gears. The helical cutters employed on this machine are 3 1/2 inches in pitch diameter and have a 1 1/4-inch hole, while the spur gear cutters are 4 inches in pitch diameter and have the same size of hole.

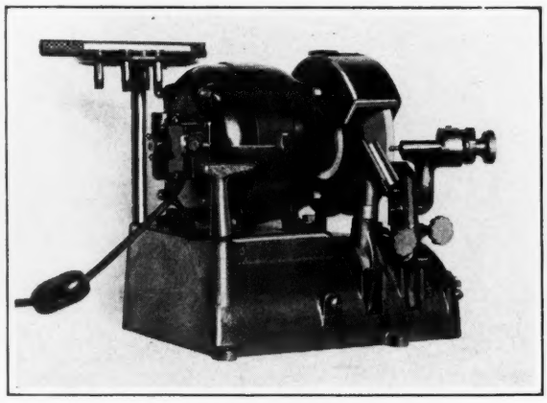
Two other machines of the line, Nos. 624A-3 and 645A-3, have the same capacities as the other machines as far as diameter of work is concerned, but are limited to the cutting of gears having a maximum face width of 3 inches. The first mentioned of these machines is adapted to the cutting of spur gears only, whereas the other will cut spur, helical, and herringbone gears.

Wells Tap and Drill Grinder

Taps and drills from 1/2 inch down to the smallest size can be sharpened in the bench machine illustrated, which is being introduced to the trade by the Wells Mfg. Co., P. O. Box 613, Greenfield, Mass. The tap or drill to be sharpened is placed in a draw-in chuck held in a quill. After



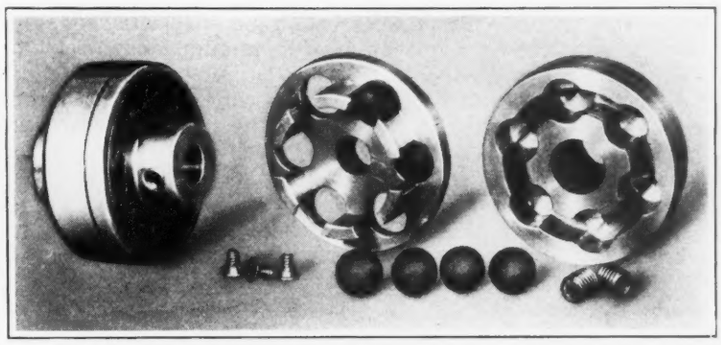
Heavy Apron and Large Work-spindle on Fellows Gear Shapers



Wells Bench Grinder Designed for Sharpening Taps and Drills

the tool has been lightly gripped in the chuck, the quill is slid into the holder seen at the left-hand end of the machine, for aligning it in the correct sharpening position. When the tool has been positioned and tightened, the quill is inserted in the holder at the right-hand end of the machine and then turned slowly toward the right for sharpening the tool. The correct relief is provided through a cam.

To thin the web, the tap or drill is placed in the holder seen at the left of the sharpening fixture. This holder is rocked to bring the tool against a second and thinner grinding wheel. The machine also gives satisfactory results in sharpening engravers' tools.



Edmunds Flexible Coupling which Employs Rubber Balls for Absorbing Shocks

Edmunds Rubber-ball Flexible Coupling

An Edmunds flexible coupling designed with the view of providing maximum shock-absorbing properties so as to reduce the wear and tear on both driving and driven machinery, is being introduced on the market by the Crocker-Wheeler Electric Mfg. Co., Ampere, N. J.

As will be seen from the illustration, the flange half of this coupling, which is at the extreme right, has six cylindrical pockets, all of which are parallel to the shaft hole. A circular groove connects these pockets. The other half or spider of the coupling has six projecting lugs between which rubber balls are placed to absorb the shocks.

When the two coupling halves are in place, the balls occupy the flange pockets. As the load being transmitted varies, the lugs on the spider squeeze the balls correspondingly and these provide the resilience needed for absorbing the shocks. All of the balls are under compression regardless of the direction of rotation. The balls can be conveniently removed for examination or renewal after taking off the cover seen on the assembled coupling at the left of the illustration. The balls can be removed without disturbing the position of the machine or either coupling half on its shaft.

In normal service, the balls will last for years without renewal, but in cases of severe-shock loads and heavy overloads, it may be necessary to change them once a year. This coupling does not need any lubrication. Standard sizes are made for transmitting from 1/8 to 35 horsepower at 100 revolutions per minute. Maximum speeds range from 10,000 revolutions per minute for the smallest size to 1800 revolutions per minute for the largest size.

Red-E Tool-holders for Tungsten-carbide Bits

Tool-holders designed especially for tungsten-carbide bits are being placed on the market by the Ready Tool Co., 550 Iranistan Ave., Bridgeport, Conn. These tool-holders have been designed with a view to eliminating the need of brazing tungsten-carbide

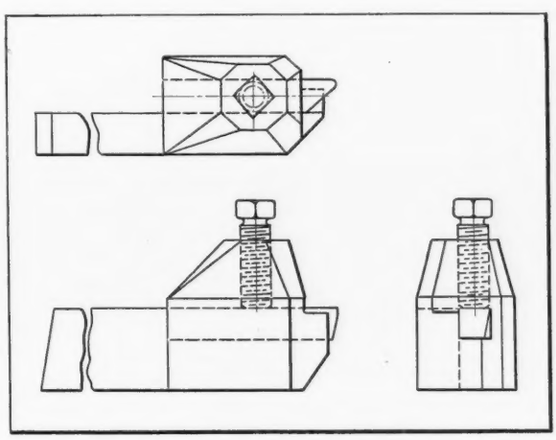


Fig. 1. Red-E Tool-holder Designed to Support Tungsten-carbide Bits Firmly

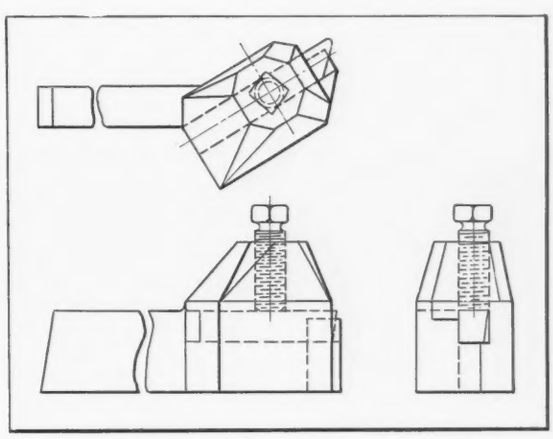


Fig. 2. Offset Type of Tungsten-carbide Bit Holder Made in Right- and Left-hand Styles

bits to steel shanks. From the illustrations it will be seen that the cutter bit is firmly supported on the bottom against the pressure of the work when a cut is being taken. It is also well supported on the side against the pressure that is developed in feeding the cutter bit into the work.

These tool-holders are made in both right- and left-hand styles, and in straight and offset types. They are obtainable with any size of shank and with any desired size of hole for the bit. This hole can be broached with a back slope or angle if desired. The tool-holders are adaptable for use on engine lathes, screw machines, turret lathes, and similar machines.

Automatic Sizing Device for Cincinnati Centerless Grinders

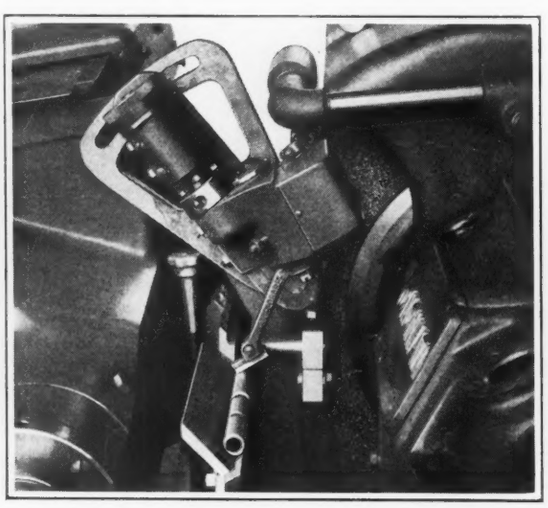
Through the use of an automatic sizing device, it is now possible to grind cylindrical work in centerless grinding machines built by the Cincinnati Grinders, Inc., Cincinnati, Ohio, without the necessity of checking the parts frequently or of adjusting the feed-wheel slide. In the centerless method of grinding, the throat dimension between the grinding wheel and the feed-wheel determines the size of the piece being ground. As the wheels wear, the grinding throat becomes larger and, accordingly, the diameter of the work increases. When this occurs, the automatic sizing device advances the feed-wheel in such a way as to maintain the desired throat dimension within very close limits.

From the illustration it will be seen that this sizing device includes an electric contact gage mounted on the rear of the work fixture. A closely adjusted gaging member is so arranged that as the diameter of the work increases, due to wear of the grinding wheel, this gaging member comes in contact with the work and is given a considerable arc movement. This causes an electrical contact to be made through a small mercury switch. The gaging member can be so adjusted that an increase in work diameter of 0.0001 inch will cause the electrical contact to be made.

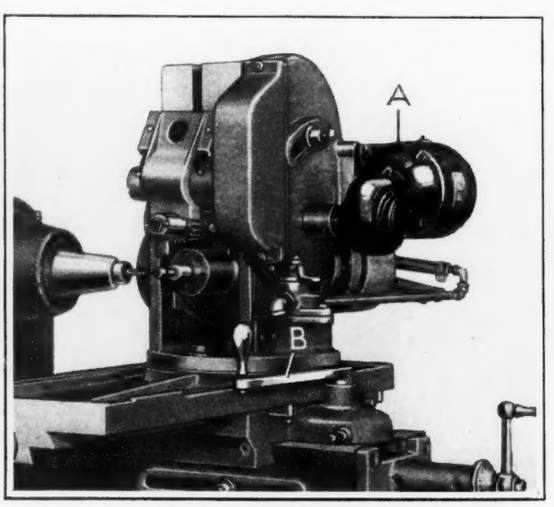
This contact energizes a solenoid connecting a valve on the feed mechanism, which, by hydraulic means, operates the in-feed slide-screw. Provision is made for in-feed movements of this slide as fine as 0.0001 inch. An adjustable needle valve on the exhaust port delays the return of the feed piston to permit work which has been ground during the adjustment to pass between the gage contacts. If the work is still large, the feed will again operate. However, if the correct size of work is obtained, the gaging member returns to the normal position and the electrical contact is broken. This automatic sizing mechanism is available for application on this company's standard No. 2 centerless grinders.

Improved Features of Peerless Gear Chamfering Machine

The work-head of the Model 3 Peerless gear-tooth chamfering machine made by the City Machine & Tool Works, E. 3rd and June Sts., Dayton, Ohio, is now operated independently of the remainder of the machine by a Master geared-head reduction motor, which is applied as shown at *A* in the accompanying illustration. This eliminates all the gearing and universal shafts formerly required for transmitting power from the motor in the base. The new arrangement also provides for more flexible



Mechanism that Automatically Compensates for Wheel Wear on Cincinnati Centerless Grinders



Geared-head Reduction Motor Applied to Work-head of Peerless Chamfering Machines

INDEXING MOVEMENTS FOR ANGLES—5*

Angle in Degrees, Minutes, and Seconds			B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond		Angle in Degrees, Minutes, and Seconds			B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond	
Deg.	Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle	Deg.	Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle
3	11	36.7	11	31	22	62	3	39	39.6	..	..	24	59
3	12	12.2	..	..	21	59	3	40	0	11	27	22	54
3	12	51.4	..	..	15	42	3	40	24.4	20	49	20	49
3	13	35.1	..	..	19	53	3	40	54.5	..	..	27	66
3	13	50.7	14	39	14	39	3	41	32.3	16	39	16	39
3	14	24.0	..	..	9	25	3	42	21.1	7	17	21	51
3	15	19.1	17	47	17	47	3	43	2.6	..	..	19	46
3	15	31.0	..	..	21	58	3	43	26.9	12	29	24	58
3	16	21.8	12	33	24	66	3	43	54.1	17	41	17	41
3	17	33.6	15	41	15	41	3	44	9.0	..	..	22	53
3	18	0	..	..	11	30	3	45	0	..	..	10	24
3	18	22.0	18	49	18	49	3	46	2.7	18	43	18	43
3	18	56.8	7	19	21	57	3	46	27.0	13	31	26	62
3	19	33.9	..	..	17	46	3	47	22.1	8	19	24	57
3	20	0	10	27	20	54	3	48	48.8	..	..	25	59
3	20	19.3	..	..	23	62	3	49	5.4	14	33	28	66
3	20	55.8	16	43	16	43	3	49	47.2	20	47	20	47
3	21	10.5	..	..	19	51	3	50	0	..	..	23	54
3	21	21.3	..	..	22	59	3	51	25.7	21	49	21	49
3	22	30.0	6	16	9	24	3	52	45.5	..	..	25	58
3	23	46.4	..	..	20	53	3	52	56.4	..	..	22	51
3	24	19.4	14	37	14	37	3	53	30.8	16	37	16	37
3	24	32.7	..	..	25	66	3	54	0	..	..	13	30
3	24	49.6	11	29	22	58	3	54	20.3	..	..	23	53
3	25	42.8	8	21	16	42	3	54	46.9	10	23	20	46
3	26	28.2	..	..	13	34	3	55	9.6	..	..	27	62
3	26	48.5	18	47	18	47	3	55	23.0	17	39	17	39
3	27	41.5	15	39	15	39	3	56	15.0	7	16	..	..
3	28	25.2	..	..	22	57	3	56	50.5	..	..	25	57
3	29	1.9	12	31	24	62	3	57	4.3	18	41	18	41
3	29	23.2	19	49	19	49	3	57	16.3	..	..	29	66
3	30	0	7	18	21	54	3	57	36.0	..	..	11	25
3	30	30.5	..	..	23	59	3	57	57.9	..	..	26	59
3	30	43.9	16	41	16	41	3	58	14.1	..	..	15	34
3	31	18.2	9	23	18	46	3	58	36.2	19	43	19	43
3	31	45.8	..	..	20	51	4	0	0	8	18	24	54
3	32	8.5	..	..	11	28	4	1	16.6	21	47	21	47
3	32	43.6	13	33	26	66	4	1	34.7	..	..	17	38
3	33	9.4	..	..	15	38	4	2	4.1	13	29	26	58
3	33	29.3	17	43	17	43	4	2	26.9	22	49	22	49
3	33	57.7	..	..	21	53	4	3	0	9	20	..	..
3	34	8.2	..	..	23	58	4	3	31.7	..	..	23	51
3	36	0	8	20	12	30	4	3	52.2	14	31	28	62
3	37	44.5	..	..	25	62	4	4	17.1	..	..	19	42
3	37	53.6	..	..	23	57	4	4	31.7	..	..	24	53
3	38	17.8	19	47	19	47	4	5	27.2	15	33	30	66
3	38	34.2	..	..	17	42	4	6	18.9	..	..	26	57
3	38	55.1	15	37	15	37	4	6	31.3	..	..	21	46

*Previous tables in this series were published in December, 1930, and January, 1931, MACHINERY.

Copyright, 1931, The Industrial Press, New York

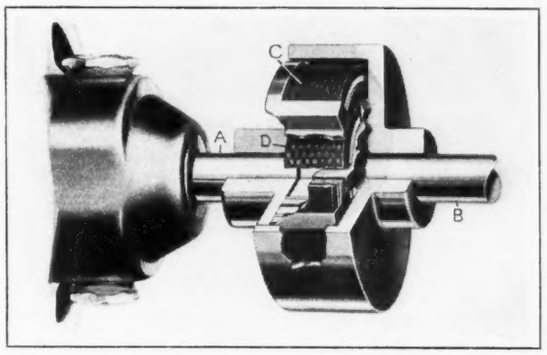
MACHINERY'S Data Sheet No. 199, New Series, April, 1931 Contributed by Edgar F. Hedden

INDEXING MOVEMENTS FOR ANGLES—6

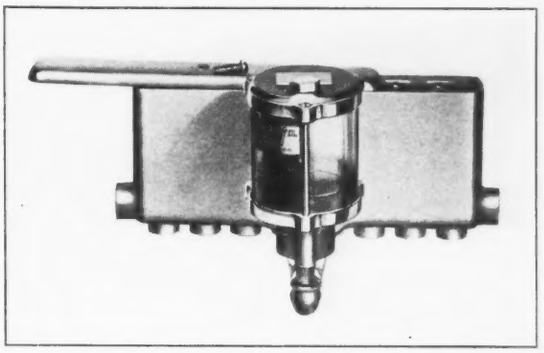
Angle in Degrees, Minutes, and Seconds			B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond		Angle in Degrees, Minutes, and Seconds			B. & S., Becker, K. & T., Hendey, and Rockford		Cincinnati and LeBlond	
Deg.	Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle	Deg.	Min.	Sec.	No. of Holes	Circle	No. of Holes	Circle
4	7	7.1	..	..	27	59	4	39	18.6	15	29	30	58
4	7	30.0	..	..	11	24	4	40	0	14	27	28	54
4	8	6.4	17	37	17	37	4	40	48.0	..	..	13	25
4	9	13.8	18	39	18	39	4	41	44.3	12	23	24	46
4	10	0	..	..	25	54	4	42	51.4	11	21	22	42
4	10	14.6	19	41	19	41	4	43	43.7	..	..	31	59
4	10	42.8	..	..	13	28	4	44	12.6	10	19	30	57
4	11	9.7	20	43	20	43	4	45	17.0	..	..	28	53
4	11	22.7	..	..	27	58	4	45	52.9	9	17	27	51
4	12	0	7	15	14	30	4	46	21.8	..	..	35	66
4	12	34.8	..	..	29	62	4	46	31.8	26	49	26	49
4	12	45.9	22	47	22	47	4	47	14.0	25	47	25	47
4	13	28.1	23	49	23	49	4	47	25.1	..	..	33	62
4	13	38.1	..	..	31	66	4	48	0	8	15	16	30
4	14	7.0	8	17	24	51	4	48	37.2	..	..	31	58
4	14	43.0	..	..	25	53	4	48	50.2	23	43	23	43
4	15	47.3	9	19	27	57	4	49	17.1	..	..	15	28
4	16	16.2	..	..	28	59	4	49	45.3	22	41	22	41
4	17	8.5	10	21	20	42	4	50	0	..	..	29	54
4	18	15.6	11	23	22	46	4	50	46.1	21	39	21	39
4	19	12.0	..	..	12	25	4	51	53.5	20	37	20	37
4	20	0	13	27	26	54	4	52	30.0	..	..	13	24
4	20	41.3	14	29	28	58	4	52	52.8	..	..	32	59
4	21	17.4	15	31	30	62	4	53	28.7	..	..	25	46
4	21	49.0	16	33	32	66	4	53	41.0	..	..	31	57
4	22	42.1	18	37	18	37	4	54	32.7	18	33	36	66
4	23	4.6	19	39	19	39	4	55	28.3	..	..	29	53
4	23	24.8	20	41	20	41	4	55	42.8	..	..	23	42
4	23	43.2	21	43	21	43	4	56	7.7	17	31	34	62
4	24	15.3	23	47	23	47	4	56	28.2	..	..	28	51
4	24	29.3	24	49	24	49	4	57	0	11	20	..	..
4	24	42.3	..	..	25	51	4	57	33.0	27	49	27	49
4	24	54.3	..	..	26	53	4	57	55.3	16	29	32	58
4	25	15.7	..	..	28	57	4	58	25.2	..	..	21	38
4	25	25.4	..	..	29	59	4	58	43.4	26	47	26	47
4	30	0	10	20	27	54	5	0	0	10	18	30	54
4	34	34.5	..	..	30	59	5	1	23.7	24	43	24	43
4	34	44.2	..	..	29	57	5	1	45.8	..	..	19	34
4	35	5.6	..	..	27	53	5	2	2.0	..	..	33	59
4	35	17.6	..	..	26	51	5	2	24.0	..	..	14	25
4	35	30.6	25	49	25	49	5	2	43.6	..	..	37	66
4	35	44.6	24	47	24	47	5	2	55.6	23	41	23	41
4	36	16.7	22	43	22	43	5	3	9.4	..	..	32	57
4	36	35.1	21	41	21	41	5	3	45.0	9	16	..	..
4	36	55.3	20	39	20	39	5	4	36.9	22	39	22	39
4	37	17.8	19	37	19	37	5	4	50.3	..	..	35	62
4	38	10.9	17	33	34	66	5	5	13.0	13	23	26	46
4	38	42.5	16	31	32	62	5	5	39.6	..	..	30	53

Copyright, 1931, The Industrial Press, New York

MACHINERY'S Data Sheet No. 200, New Series, April, 1931 Contributed by Edgar F. Hedden



Rawson Automatic Starter and Flexible Coupling



Oil-feed Unit with Constant-level Oil Control

operation and a more convenient method of changing speeds.

Another recent improvement includes a quick traverse for the work-table. This furnishes a means of reducing the loading and unloading time, particularly in chamfering internal gears. The quick traverse mechanism is operated through lever *B*.

The remainder of the machine is the same as described in February MACHINERY, page 469.

Rawson Automatic Starter and Flexible Coupling

The Rawson automatic starter and flexible coupling, which has been placed on the market by the Washburn Shops of the Worcester Polytechnic Institute, Worcester, Mass., has been designed to reduce starting load requirements and absorb shock and vibration. This device consists of two cast-iron members, one of which is attached to the driving shaft *A* and the other to the driven shaft *B*. Between the driving and driven members are floating segments made of brake lining reinforced with lead. There is a sufficient amount of lead to give the required pressure on the friction surfaces to carry the load. Clearance is allowed between the driving and driven members, and also between the floating friction surfaces.

When power is applied to the driving shaft, the shaft attains the required speed almost instantly, as there is at first no resistance to its action. With the application of the power, centrifugal force begins to act on the outer set of linings *C*. There is sufficient lag, however, to allow the driving member to come to full speed before the centrifugal force affects the driven member. The design is such that the centrifugal action on the driving side is never greater than the motor rating.

In starting a load with a clutch capacity for only the rated motor power, some time would be required and considerable heat might be developed. In order to overcome this objection and to give sufficient overload capacity, there is a second set of centrifugal friction linings *D* on the driven side. As soon as the driven side starts to revolve, centrifugal action begins to take place on this side of the starter and the action comes through the second set of friction linings. These linings are thrown against the friction surface of the driving side and thus provide an auxiliary source of driving.

This auxiliary power can be varied to suit the type of load and the overload requirements. The starter is usually applied to motors, but it may be applied to other types of driving units, as well as to driven units. It is made in a large range of sizes.

Daun-Walter Lubricating Devices

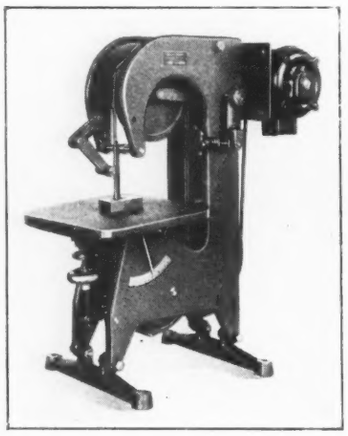
An adjustable-wick oil-feed unit which controls the amount of oil delivered from a reserve supply is being introduced to the trade by the Daun-Walter Co., 508 N. Water St., Milwaukee, Wis. This unit, as shown in the illustration, consists of a constant-level oil control and a wick box. The control provides an adequate storage of oil and maintains a constant oil level in the wick chamber. The latter is an aluminum casting with a removable cover and is made with four, eight, or twelve outlet units to provide for lubricating a like number of bearings.

Horizontal outlets on each end of the box enable the hooking up of other wick units located on the same level. Each wick loop can be adjusted to regulate the quantity of oil fed by the wick. It is possible to maintain a minimum of four drops of oil per hour.

The constant-level oil control is also available as a separate unit for use in lubricating all types of machine bearings.

Grob Continuous Filing Machine

A bench type of machine with files arranged in a continuous band has recently been added to the equipment made by Grob Bros., 90th and National Aves., West Allis, Wis. This machine is designed for either external or internal filing of small- and medium-sized work. It is basically suited to toolmaking and diemaking in that flat surfaces up to 4 inches in height can be finished within close tolerances. In the illustration, a blanking die is shown set up on the table for finish-filing the opening. Features of the machine include the automatic application of tension in the main driving belt, a



Grob Filing Machine with Files Linked in a Continuous Band

positive drive to the file chain, a full-support back-rest, a positive adjustment for the work-table, a combination of three filing speeds, and a band of files that affords a continuous cutting action. The files are joined by links which permit them to operate over two sheaves. A V-belt drive is employed.

The work-table can be adjusted 25 degrees toward the front or back, settings being facilitated by a graduated plate and pointer. This machine is 29 inches high and occupies a space of 15 by 15 inches. It is equipped with a 1/4-horsepower motor and weighs 150 pounds.

Buffalo Hand-operated Shears

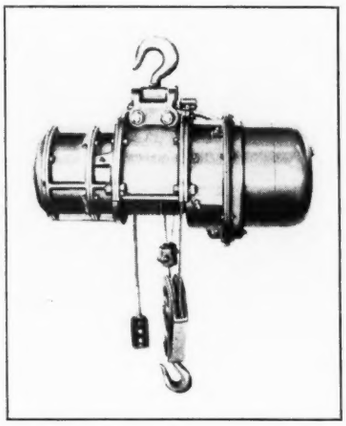
A hand-operated outfit that can be conveniently moved from one job to another has been added to the line of "Armor-Plate" shears built by the Buffalo Forge Co., Buffalo, N. Y. This equipment is suitable for cutting both round and flat bars. The piece of pipe used as a truck handle in the manner illustrated is also employed for operating the shear lever.

In addition to the model illustrated, this shear is made in a bench style and with an angle-iron floor stand. These shears will cut flat bars up to 3 by 5/8 inch.

Lyon Hydraulic Lift Truck

Loads up to 6000 pounds may be lifted and lowered hydraulically with a hand-operated truck recently placed on the market by the Lyon Iron Works, Greene, N. Y. The lifting arrangement is designed on the principle of a hydraulic jack. To elevate a load, the handle is merely operated up and down with either long or short strokes. Full strokes are used for quickly raising moderate loads and short strokes for extra heavy loads or when the truck is in a congested place. To lower a load, a lever located on the handle bar is pressed. The load may be stopped at any point by merely releasing the pressure on this lever.

The truck is made in different models with platforms either 17 or 26 1/2 inches wide and of various lengths. These models are also made in different lift heights and with various wheel diameters.

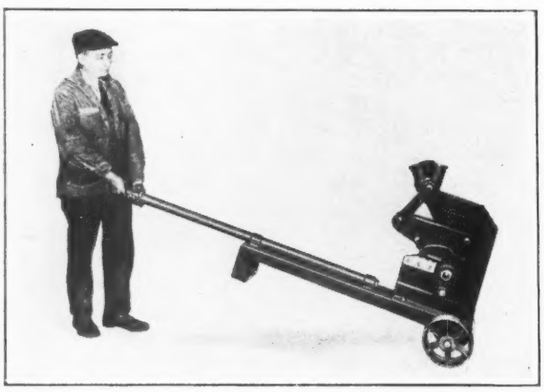


Wright Electric Hoist Designed for Operating at High Speeds

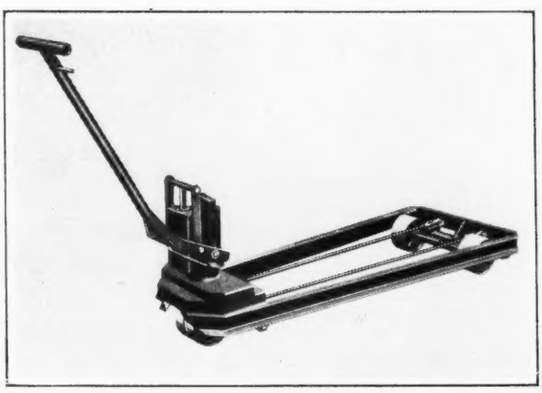
Wright High-speed Electric Hoist

Electric hoists of the construction shown have been designed by the Wright Mfg. Co., Bridgeport, Conn., for installations where high operating speeds are essential. The motors are of a liberal size and were designed especially for this type of hoist. It is stated that low-cost maintenance is insured by the simple construction of the hoists and the use of alloy steel shafts, drop-forged heat-treated gears and pinions, and "Tru-Lay" preformed cable.

Different types of suspensions are available and the hoists may be furnished with either a push-button or pendant-rope control. The motors and controls are fully enclosed, so that they are suitable for outdoor as well as indoor installations.



Truck Type of Hand-operated Shear Made by Buffalo Forge Co.

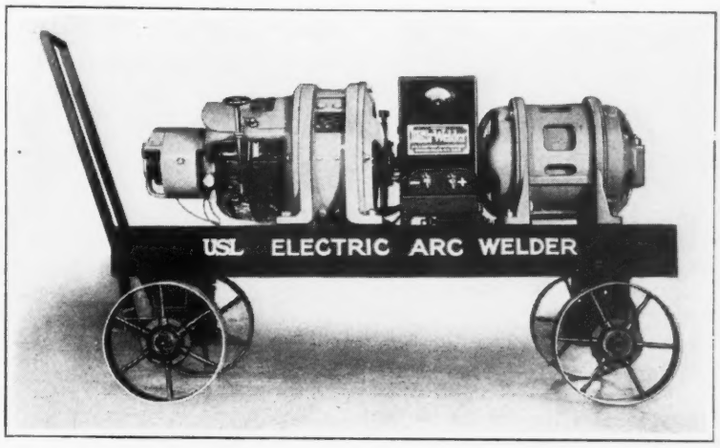


Lyon Hand Truck with Hydraulic Lifting and Lowering Means

USL "Full Range" Arc Welder

An arc welder termed "Full Range" because it provides an infinite number of accurate welding-current adjustments, is being introduced to the market by the Arc Welder Division of the USL Battery Corporation, Niagara Falls, N. Y. All current adjustments are made by means of a simple electrode indicator which is set by the operator to suit the size of electrode being used. There are no voltage adjustments of any kind and no switches or rheostats for current adjustment.

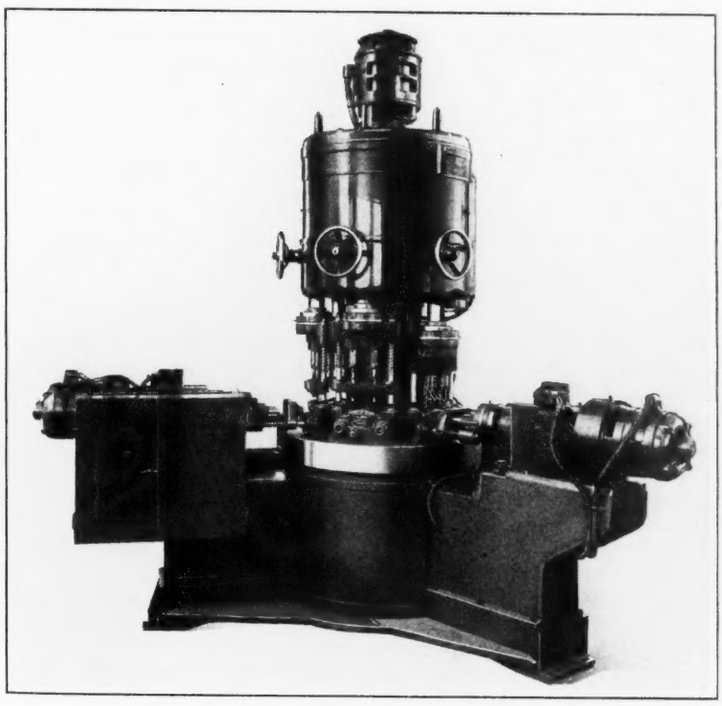
Another advantage claimed for this welder is a high-striking voltage of 60 volts, which is constant for all commercial sizes of electrodes, either coated or bare. The generator has been designed with a view to producing an arc that prevents the burning of light work and insures deep penetration on heavy work.



USL Arc Welder with an Infinite Number of Welding Current Adjustments

Ex-Cell-O Vertical Automatic Machine

An automatic machine of vertical design has been developed recently by the Ex-Cell-O Aircraft & Tool Corporation, 1200 Oakman Blvd., Detroit, Mich., for performing multiple operations in one or more holes of a part. The machine illustrated is equipped with three auxiliary horizontal units required for drilling, reaming, and tapping a horizontal hole in a bronze part.



Ex-Cell-O Automatic Machine for Drilling, Reaming, Tapping and Similar Operations

The vertical spindles are contained in a single unit in the upper portion of the machine, and are driven by one motor. The speeds of these spindles may be changed to suit the individual job, and can be arranged to suit either a multiple-head mounting or a single spindle.

On the machine illustrated, all the units are equipped with multiple heads having two to four spindles. Each of these heads is equipped with spring guide bars and bushing plates. The guide bars not only carry the bushing plates, but also insure accurate alignment between the drill head and the fixture as the work is indexed from one station to another. The cycle of each unit can be accurately timed in relation to the others for different operations. A pump forces oil to a reservoir at the top of the machine and distributes it to the various points of the mechanism contained in the housing.

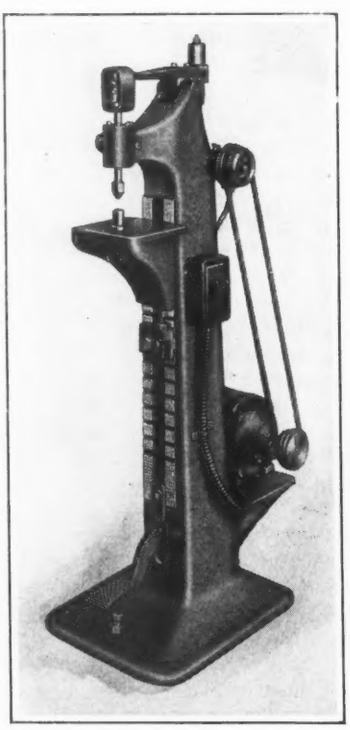
A five-station rotary table carries the fixtures for holding the parts during the various operations, two parts being placed in each fixture. The base of the vertical unit contains the index mechanism for rotating the table. This mechanism is easily accessible for adjustment.

Four operations are performed by the vertical units and three by the horizontal units. The entire cycle of the machine is electrically controlled by relay switches mounted in a panel box on the horizontal unit at the left.

Grant Riveting Hammer

Rivets from 3/16 to 5/16 inch in diameter can be headed cold in a No. 3A riveting hammer recently added to the line of machines built by the Grant Mfg. & Machine Co., N. W. Station, Bridgeport, Conn. This type of riveting machine is known as a "vibratory hammer," because the hammer spindle vibrates vertically at from 1400 to 2000 blows per minute. In general, the construction of the machine closely follows the design of the 3/8- to 1/2-inch machine described in March MACHINERY, page 545.

The main pulley has been made part of the clutch mechanism and means are provided for lubricating it. The clutch is of the friction disk type and has a Raybestos lining. When driven from a countershaft, the main pulley is furnished for a 1 1/4-inch flat belt, while a three-step cone pulley for a V-belt is supplied when the machine is motor driven. A 1-horsepower motor running at 1750 revolutions per minute is used in the latter type of drive.

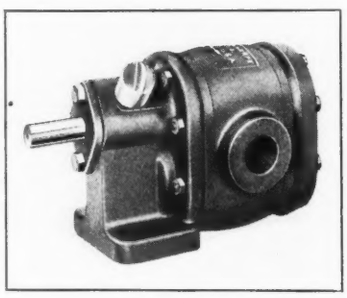


Grant Vibratory Hammer for Driving 3/16- to 5/16-inch Rivets Cold

Brown & Sharpe Rotary Geared Pumps

Rotary geared pumps of the construction illustrated have been designed by the Brown & Sharpe Mfg. Co., Providence, R. I., to supply oil under pressure for the hydraulic operation of machines. These pumps are equipped with ball bearings and spiral gears. They are made in two sizes, designated as Nos. 53 and 55.

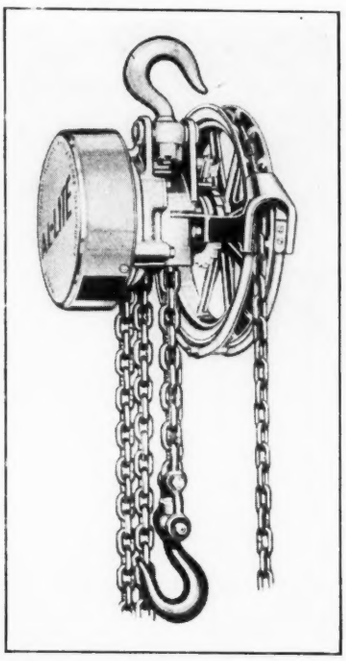
The No. 53 pump may be operated at speeds of from 300 to 1800 revolutions per minute. At the low speed, 4 1/4 gallons of oil at zero pressure are delivered per minute, and at the high speed, 25 1/2 gallons. The No. 55 pump is designed for running at



Brown & Sharpe Pump Applicable for Operating Machines Hydraulically

speeds of from 300 to 1200 revolutions per minute. At the low speed, this pump delivers 9 gallons of oil per minute at zero pressure, and at the high speed, 36 gallons. At a speed of 1200 revolutions per minute and a pressure of 100 pounds per square inch, this pump will also deliver about 36 gallons of oil per minute. The No. 53 pump weighs 26 1/2 pounds, and the No. 55 pump, 31 1/2 pounds. These pumps are designed to run in one direction only, either right- or left-hand.

The No. 55 pump is intended to replace the No. 5 pump, which has now been discontinued. The cap, stand, and housing have been made heavier and the pump has been otherwise strengthened. The suction port, including the pipe tap, has been made larger to permit a freer admittance of oil.



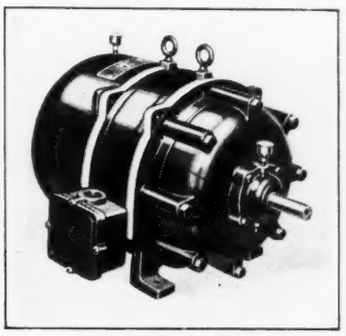
Chisholm-Moore Chain Hoist in which Most Parts are Made of an Aluminum Alloy

Chisholm-Moore Aluminum Chain Hoist

An Al-Lite chain hoist in which all parts are made of Alcoa aluminum alloy, with the exception of the pinion, pinion shaft, brake mechanism, chain, and hook, is being introduced on the market by the Chisholm-Moore Hoist Corporation, Tonawanda, N. Y. It is interesting to note that all of the gears except the pinion, are made from this alloy. The hoist weighs about one-third less than regular chain hoists. Alemite lubrication is provided. The hoist is equipped with ball bearings, planetary-type gears, a dustproof housing, and an adjustable brake.

Howell Totally Enclosed Motors

Motors of both polyphase and single-phase designs, provided with a totally enclosed frame, have been brought out by the Howell Electric Motors Co., Howell, Mich. These motors may be equipped with or without a



Howell Fan-cooled Totally Enclosed Motor

cooling fan. They are of squirrel-cage construction and may be used where gasoline vapors exist or under similar conditions.

Polyphase 25-cycle motors are manufactured in sizes from 1/2 to 5 horsepower; polyphase 60-cycle motors, in sizes from 1/2 to 10 horsepower; single-phase 25-cycle motors, in sizes from 1/2 to 3 horsepower; single-phase 60-cycle motors, in sizes from 1/2 to 5 horsepower. One of these motors is shown in the accompanying illustration.

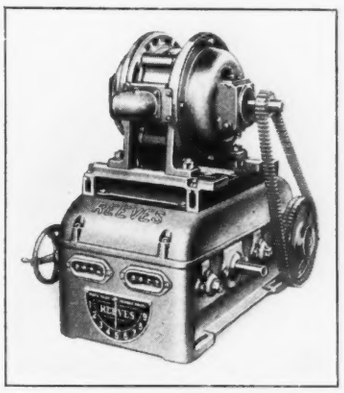
The same concern has also recently developed a new line of fractional-horsepower motors with capacities ranging from 1/10 to 1/3 horsepower. This line comprises condenser, split-phase and polyphase motors. All of them are provided with a frame of the same dimensions. Either ball or sleeve waste-packed bearings are furnished.

Reeves Enclosed Variable-Speed Transmission

The Reeves Pulley Co., Columbus, Ind., has recently produced a variable-speed transmission in which the standard internal operating parts are totally enclosed in a cast-iron case. Complete protection is thus afforded the operating parts in all applications where they must be guarded from water, steam, chemical fumes, or abrasives.

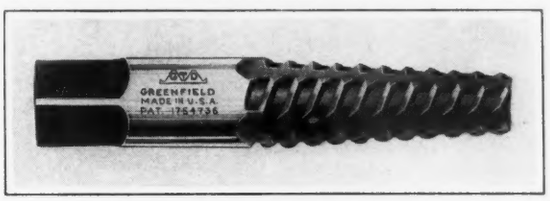
Easy access is provided to the internal operating parts by U-shaped recesses in the sides of the bottom section of the case, which permit the operating parts to be removed as a unit. The bearings of the two shafts can be removed as well as the shifting and belt-tightening screws. Removal of the lid from the cover section permits minor adjustments, inspection of the internal operating parts, or installation of a new V-belt.

One of the features of the new transmission is an improved lubrication system. All bearings are lubricated through force-feed fittings located in two recessed panels at one end of the transmission. From the eight fittings, tubes lead to four radial shaft bearings and to four thrust bearings which fit around the disk hubs.



Reeves Transmission with Variable-speed Unit Entirely Enclosed

This enclosed transmission is built in six sizes, covering requirements from fractional to 10 horsepower, in all speed ranges. It can be mounted on the floor, ceiling, or in a vertical position. In the illustration, the transmission is shown with a motor mounted on top and connected by a silent chain.



Screw Extractor Made in Thirteen Sizes by the Greenfield Tap & Die Corporation

Dial Indicator Finger for Use in Inaccessible Places

Barber-Colman Indicator Finger

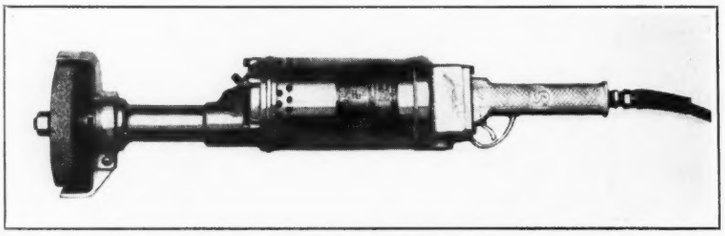
A finger which allows the application of dial indicators in places that are inaccessible to an ordinary indicator has been devised by the Barber-Colman Co., Rockford, Ill. As illustrated, this finger is clamped to the case barrel which surrounds the indicator plunger in such a manner that the curved end of the bellcrank rests against the end of the plunger. Thus, a movement imparted to the ball end of the bellcrank is transferred accurately to the indicator. The finger can be attached and removed with ease.

The frame of the finger is a steel forging and the bellcrank is a tool steel stamping. A stop lug on the bellcrank prevents it from dropping below a normal working position. The device is given a dull black finish and the ball end is polished. The clamping hole in the frame is made to fit a 9/32-inch diameter indicator barrel.

"Little Giant" Screw Extractors

Screw extractors which feed themselves into holes drilled in broken screws or studs are being placed on the market by the Greenfield Tap & Die Corporation, Greenfield, Mass. The design of these extractors is such that broken screws or studs are not expanded and jammed in the tapped holes.

Thirteen sizes are made, ranging from 1/16 to 1 27/32 inches in diameter at the small end and from 1/8 to 2 9/32 inches in diameter at the large end. The thread length ranges from 1/2 to 3 1/2 inches. Six sets comprising different sizes are available to meet the needs of machine shops, garages, service stations, etc.

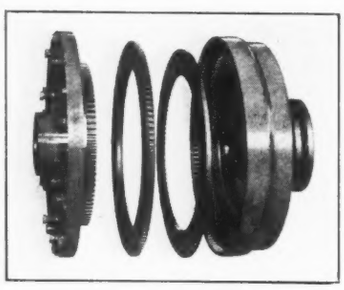


Electrically Driven Hand Grinder and Buffer Made by the Standard Electrical Tool Co.

Stearns Multiple-disk Magnetic Clutch

The Magnetic Mfg. Co., Milwaukee, Wis., has developed a multiple-disk magnetic clutch which can be supplied in high horsepower ratings. It is shown disassembled in the accompanying illustration.

While this clutch has been designed to transmit maximum horsepower and has unusual "pull-out-torque," it is said to possess the advantages of smaller magnetic clutches, such as ease of operation, smooth acceleration, and low maintenance cost. The clutch shown in the illustration is 24 inches in diameter and develops more than 6500 foot-pounds of pull-out-torque. The pressure per square inch is low.



Stearns Magnetic Clutch Made in High Horsepower Capacities

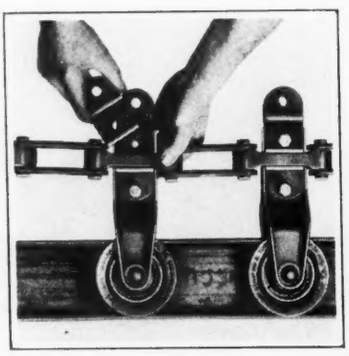
Portable Electric Grinder and Buffer

The electrically driven hand grinder and buffer here illustrated has recently been placed on the market by the Standard Electrical Tool Co., 1948 W. 8th St., Cincinnati, Ohio. This device is equipped with a 1/2-horsepower high-frequency motor for operating on 220-volt 60-cycle, three-phase alternating current. The speed of the grinding spindle is 5400 revolutions per minute.

The grinding wheel is 6 inches in diameter by 1 inch thick and has a 5/8-inch bore. High-speed wheels bonded with Bakelite are employed. S K F ball bearings are provided. The switch is of the trigger type. The over-all length of this grinder and buffer is 26 inches, and the maximum diameter is 4 1/2 inches. The weight is 20 1/2 pounds.

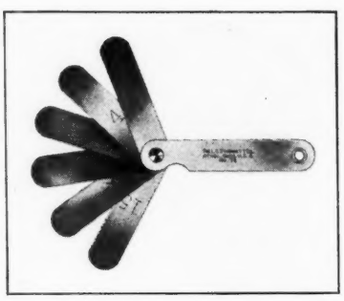
Improved Conveyor Trolley and Chain

In an improved steel conveyor trolley recently produced by the Saginaw Products Corporation, Saginaw, Mich., the bracket assembly extends through the chain link in the manner illustrated. The chain attachment lugs are bolted direct to the bracket tongue. The tongue projects below the lower side of the chain.



Attaching Conveyor Chain to Saginaw Steel Trolley

In attaching the chain, it is only necessary to raise it so that the bracket tongue projects through the proper link and then bolt the attachment lugs in place. One bolt secures both lugs and one man can easily perform the assembly. The trolley is delivered to the purchaser ready for installation on a conveyor track, and thus conveyor erection is facilitated.



Starrett Thickness or Feeler Gage with Six Leaves

Starrett Thickness Gage

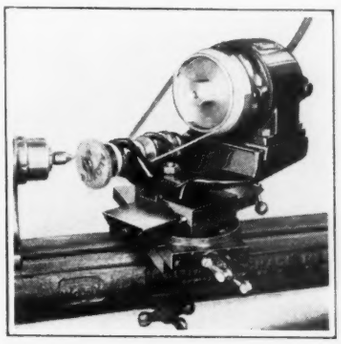
A thickness gage with six leaves that give a range of from 0.0015 to 0.031 inch, in thousandths of an inch, has been added to the products of the L. S. Starrett Co., Athol, Mass. The leaf thicknesses are 0.0015, 0.002, 0.003, 0.004, 0.006, and 0.015 inch.

The leaves are protected by a steel case and held by a screw and stud arrangement which allows them to be replaced conveniently in the event that they should become damaged. An eyelet is provided in the end of the case to permit the gage to be carried on a ring. As the length of the gage is less than 3 inches, it will fit readily into a pocket.

"Layth-Grindar" Precision Bench-Lathe Grinder

A motor-driven multi-speed grinder designed for application to bench lathes has been added to the line of precision lathe grinding attachments made by the Layth-Grindar Corporation, 28 Canfield St., Orange, N. J. This bench-lathe grinder is made in two sizes, both of which are driven by 110-volt universal motors. One grinder is equipped with a 1/30-horsepower motor which gives spindle speeds of 12,000 and 22,000 revolutions per minute through two-step pulleys. The other grinder has a 1/20-horsepower motor by means of which spindle speeds of 10,000 and 20,000 revolutions per minute are obtainable. Standard makes and sizes of motors are employed.

Aluminum pulleys are provided on both the motor shaft and spindle. A Tilton endless canvas belt is used for transmitting the drive. Correct tension of the belt is maintained by means of an adjusting screw which moves the motor forward or backward on a base. The standard bearing construction for the spindle is a double-taper cast-iron bearing in front, a phosphor-bronze parallel bearing at the rear, and a ball thrust bearing at the rear. Spiral oil-grooves with adequate oil space and felt washers that prevent the loss of oil make this combination of bearings satisfactory. Ball bearings can be supplied if preferred.



Grinder Designed Primarily for Use on Bench Lathes

Removal of the endless belt is easily accomplished by slipping the spindle from its bearings after loosening two check-nuts at the rear of the spindle. The spindle can be conveniently adjusted to suit the heights of different bench lathes by means of ground shims, which are supplied in dimensions corresponding to the baseplate and in thicknesses of 1/16, 1/8, and 3/16 inch.

For external grinding, the wheel is mounted directly on the spindle, while for internal grinding extension arbors are furnished.

Personals

GEORGE H. DAVIS has been transferred from the Milwaukee office of Gears & Forgings, Inc., Cleveland, Ohio, to the Pittsburgh district sales office at 2818 Smallman St.

H. R. KRUEGER was elected vice-president in charge of engineering of the Ex-Cell-O Aircraft & Tool Corporation, Detroit, Mich., at a recent meeting of the board of directors. Mr. Krueger organized the H. R. Krueger Co. in 1921. This company was combined with the Wayne Tool Co. in 1929 to form the Airparts & Tool Co., which latter organization was acquired by the Ex-Cell-O Aircraft & Tool Corporation in 1930.

H. R. Krueger

CLARK P. POND has been appointed vice-president of engineering and sales with the Truscon Steel Co., 6100 Truscon Ave., Cleveland, Ohio. Mr. Pond was formerly connected in a similar capacity with the David Lupton's Sons Co.

TELL SCHIRNDING BERNA has been appointed general sales manager of the National Acme Co., Cleveland, Ohio. Mr. Berna formerly served as sales manager of the Cutler-Hammer Mfg. Co., the G. A. Gray Co., and the Union Twist Drill Co.

JOHN W. BLACKFORD, for the last eight years with the Torrington Co., Torrington, Conn., and for the last two years manager of the Detroit office of this company, has joined the sales organization of the Norma-Hoffmann Bearings Corporation, Stamford, Conn.

H. W. ANDERSON was elected assistant secretary of Whitman & Barnes, Inc., Detroit, Mich., at the last annual stockholders' meeting. The following officers were re-elected for the current year: William H. Eager, president; Karl Kendig, vice-president and treasurer; and J. I. Holton, secretary.

LEWIS A. WAY has been made manager of production and sales of the roll department at the Ellwood plant of the Aetna-Standard Engineering Co., Youngstown, Ohio. Mr. Way was formerly vice-president of sales with the Pittsburgh Steel Foundry Corporation, and prior to that, president of the Sharon Foundry Co.

WILLIAM F. WISE was elected vice-president in charge of sales of the Ex-Cell-O Aircraft & Tool Corporation, Detroit, Mich., at a recent meeting of the board of directors. Mr. Wise has had twenty years' experience in the machine tool field. When the Ex-Cell-O company entered the aircraft field, Mr. Wise handled the aircraft sales.

William F. Wise

WILLIAM B. TODD has been appointed general manager of sales of the Jones & Laughlin Steel Corporation, Pittsburgh, Pa. He was formerly assistant general manager of sales. In 1922, he resigned a vice-presidency in the Union Drawn Steel Co. to join the Jones & Laughlin sales staff as manager of sales of the cold finished division.

MYRON E. FORBES has been appointed vice-president in charge of financial matters of the Oliver Farm Equipment Co., Chicago, Ill. Mr. Forbes was president of the Pierce-Arrow Motor Car Co. until the company was purchased by the Studebaker Corporation. Previously, Mr. Forbes was associated in various executive capacities with Deere & Co.

WALTER W. BRICKA, general manager and a director of the Goodell-Pratt Co., Greenfield, Mass., severed his connection with that company on March 31. Mr. Bricka, who is an associate of the Ellery A. Baker Co., industrial managers, of New York City, has managed the Goodell-Pratt Co. for the last two years, and is terminating his services with that company upon the merger of the Goodell-Pratt Co. and the Millers Falls Tool Co.

F. C. ENGELHART was elected president of the Kester Solder Co., Chicago, Ill., at a recent meeting of the board of directors. Mr. Engelhart has been the directing head of the company for the last twenty years, acting as general manager

F. C. Engelhart

and treasurer. J. A. REITZEL, formerly sales promotion manager, has been made general sales manager.

E. M. VEHMEYER has become manager of the Detroit plant of Joseph T. Ryerson & Son, Inc., Chicago, Ill. Mr. Vehmeyer has been associated with the Ryerson concern for over twenty-two years. The major portion of this time he has spent in the sales and service departments. For the last two years he has been sales manager of the Detroit plant. W. H. BASSE, formerly Detroit plant manager, has been transferred to Chicago, where he will engage in special sales work.

Obituaries

Stanley H. Bullard

Stanley H. Bullard, vice-president and works manager of the Bullard Co., Bridgeport, Conn., died of heart disease March 22 at his home in Fairfield, Conn., aged fifty-three years. Mr. Bullard was born in Hoboken, N. J., the son of E. Payson Bullard, founder of the Bullard Co. After graduating from a military academy in 1890, he became an apprentice in the Bullard works. He later entered the sales department and managed the Bullard exhibit at the Pan-American Exposition in 1901. In 1905 he became general sales manager, and in 1915, vice-president and works manager.

Mr. Bullard has been a director of the Chamber of Commerce of the United States, and was an original member and a director of the Bridgeport Chamber of Commerce, as well as one of the original members of the New England Council formed five years ago. He was also a member of the Storrow Committee on New England Railroads, and a director of the Home Building and Loan Association and of the Fairfield Bank & Trust Co. He was a member of the American Society of Mechanical Engineers, the Society of Automotive Engineers, and the Bridgeport Engineering Institute, and was widely known in machinery and engineering circles. He was especially active in the National Machine Tool Builders' Association. He was secretary of the Fairfield Board of Education and a member of its Building Committee. Mr. Bullard is survived by his wife and three children.

Winfield Scott Rogers

Winfield Scott Rogers passed away at his home in South Orange, N. J., February 17, following seven weeks of illness. Mr. Rogers was a pioneer in the ball bearing industry in this country. He became associated with the late Henry M. Whitney in 1898 as general manager of the Ball Bearing Co. of Boston. It was due largely to his early pioneering efforts that the value of friction-saving bearings became recognized in the mechanical world. He published the first commercial catalogue of ball bearings issued in this country. In 1905 he organized the Bantam Ball Bearing Co. of Bantam, Conn. Until his retirement two years ago, he remained president and active head of this company, which was moved to South Bend, Ind., in 1928. Mr. Rogers also served two terms in the Connecticut State Legislature. He is survived by his widow, Nellie S. Rogers.

Henry Clay Graton

Henry Clay Graton, one of the founders of the Graton & Knight Co., Worcester, Mass., died Friday, March 20, in his one hundred and first year. In 1851, with Joseph Knight, he formed for the manufacture of leather belting the company identified by the names of the founders. Mr. Knight was in charge of manufacturing and Mr. Graton in charge of sales. In 1867, the partners established a tannery, and saw it grow from a capacity of 7500 hides a year to 200,000 a year. Until Mr. Graton's retirement at the age of ninety, he was treasurer and general manager of the company.

John G. Ladrick

JOHN G. LADRICK, for 41 years connected with the Cleveland Twist Drill Co., Cleveland, Ohio, died recently in Geneva, Switzerland. Mr. Ladrick was

John G. Ladrick

born in 1866 in Thun, Switzerland. He came to the United States at the age of seventeen and made his home with relatives in Hannibal, Ohio. Later he went to Cleveland, where he entered the employ of the George Worthington Co. In 1889 he entered the employ of the Cleveland Twist Drill Co. For many years he served the company's customers in practically every section of the country. For the last twenty years he has represented the company in the territory west of the Rocky Mountains, where he leaves a host of friends. Last year, illness caused him to retire.

Adrian P. Sloan

Adrian P. Sloan, chairman of the board of directors of the Cushman Chuck Co., Hartford, Conn., died February 21, at Hartford, at the age of eighty-four years. For many years, Mr. Sloan had been closely identified with the growth and development of the Cushman Chuck Co. He was born in Tolland, Conn., and came to Hartford as a young man and engaged in the mechanical industry. Later he joined the Cushman Chuck Co., where his unusual ability, force of character, and capacity for leadership soon became recognized. He rose successively from his first work as a skilled mechanic at the bench to foreman, factory superintendent, president, and chairman of the board of directors of the company. He was one of the few remaining veterans of the Civil War.

ALFRED BISHTON BOTFIELD, originator of high-temperature cement and founder of that industry in the United States, died recently in Miami, Fla., at the age of eighty-three years. Mr. Botfield, who was born in England, came to the United States nearly thirty years ago. He established the Botfield Furnace Specialties Co. of Philadelphia, Pa., and in 1907 produced a new bonding material for firebrick known as Adamant. In 1915, Mr. Botfield retired from active business, the conduct of the Botfield Furnace Specialties Co. being assumed by his son, Leonard B. Botfield, who is now president of the Botfield Refractories Co., successor of the former company.

ORVILLE P. BLAKE, district sales manager of the Inland Steel Co., at Kansas City, Mo., died in Denver, Colo., on February 25, of pneumonia. Mr. Blake first joined the Inland sales staff in 1906, as manager of the company's St. Louis office. He represented the company in Washington during the war and returned to Chicago in 1919. He traveled through the western territory until 1925, in which year he was placed in charge of the sales office in Kansas City.

JOHN A. CAVE, secretary and assistant treasurer of the Brown & Sharpe Mfg. Co., Providence, R. I., died in February. Mr. Cave entered the service of the company in 1905 as auditor. In 1914 he was elected assistant secretary, and in 1924 became secretary and assistant treasurer.

ARTHUR T. DOUD, works manager of the Louisville plant of the American Air Filter Co., known as the Reed Air Filter Co., died recently. Mr. Doud had been associated with the American Air Filter Co. for the last three and one-half years.

WILLIAM H. LEIMAN, president of Leiman Bros., Inc., 23 Walker St., New York City, manufacturers of sand blasts, and oil, air, and gas pumps, died recently at the age of sixty-eight years.

HARRY P. READMON, purchasing agent of the Chicago Pneumatic Tool Co., New York City, for the last twelve years, died February 26, at the age of fifty-three.

News of the Industry

DURIRON CO., INC., Dayton, Ohio, has established a branch office in Cleveland, Ohio, at Room 528, Leader Building, Superior Ave. and E. 6th St. E. D. Brauns will be in charge of the new office.

DIAMOND MACHINE CO., 11 Codding St., Providence, R. I., has appointed the Cleveland Duplex Machinery Co., Penton Bldg., Cleveland, Ohio, exclusive dealer for the sale of Diamond grinding and polishing machinery in the Cleveland territory.

COLUMBIA ELECTRIC MFG. CO., Cleveland, Ohio, manufacturer of electroplating generators, announces that the company has inaugurated a policy, new in the industry, of guaranteeing the brushes of its new type generators to last three years.

CLAUD S. GORDON STEEL X-RAY LABORATORY, 15th Place and Western Ave., Chicago, Ill., has been organized to offer X-ray examination service to the metal manufacturing industry. Metal parts of any size from the smallest to the largest can be handled.

FOSTER WHEELER CORPORATION, 165 Broadway, New York City, has entered the field of boiler manufacture, having acquired the plant and business of the D. CONNELLY BOILER CO., Cleveland, Ohio. The company is prepared to furnish all types of boilers in the entire range of sizes and pressures.

CONCO CRANE & ENGINEERING WORKS, DIVISION OF H. D. CONKEY & CO., Mendota, Ill., has appointed C. P. Maxson, Auditorium Garage Building, Cleveland, Ohio, as representative in the Ohio territory. Starr-Carpenter, Parks Building, Pittsburgh, Pa., has been appointed representative in the Pittsburgh territory.

WATSON-STILLMAN CO., 107 Aldene Road, Roselle, N. J., has purchased the assets and business of the BURROUGHS CO., Newark, N. J., which has specialized for many years in designing and building plastic molding hydraulic machinery, including tilting-head presses, rodless hubbing presses, and celluloid-working machinery.

DIVINE BROTHERS CO., INC., 106 Whitesboro St., Utica, N. Y., manufacturer of metal finishing equipment, announces the election of the following officers for 1931: President, Bradford H. Divine; vice-president, Robert T. Kent; treasurer, B. Dalton Divine; secretary and assistant treasurer, R. Irving Roberts; and assistant secretary, B. M. Beach.

DURIRON CO., INC., Dayton, Ohio, manufacturer of Duriron, an acid-resisting iron alloy, announces the election of the following officers: William E. Hall, president; Dudley H. Miller, vice-president; John R. Pitman, vice-president; Robert C. Schenck, secretary; E. B. Thacker, treasurer. Dudley H. Miller has been appointed general manager.

ALSTEEL PRESS CO., 12015 S. Peoria St., Chicago, Ill., has been organized to manufacture Verson all-steel punch and forging presses, press brakes, forming dies, and other machinery of arc-welded steel plate construction. The personnel formerly associated with the La Salle Machine Works, Inc., of Chicago, former builders of these presses, will continue to have charge of the management and operations.

ILLINOIS TESTING LABORATORIES, INC., 141 W. Austin Ave., Chicago, Ill., manufacturers of pyrometers, resistance thermometers and other measuring instruments for industrial use, have appointed Ernest H. Du Vivier, 30 Church St., New York City, representative of the company in metropolitan New York and northern New Jersey. F. W. Fernald, 335 Fifth Ave., Pittsburgh, Pa., has been appointed representative in western Pennsylvania and West Virginia.

DETROIT SEAMLESS STEEL TUBES CO., W. Warren and Wyoming Aves., Detroit, Mich., announces that the company has secured exclusive patent rights to a new process of lining steel tubing with other metals or alloys. In combining the inner lining metal with the outer steel shell, the two are bonded by fusion so intimately that the metals cannot be separated by mechanical means. One of the main applications of this process will doubtless be for the production of steel-backed bearing bushings.

EX-CELL-O AIRCRAFT & TOOL CORPORATION, 1200 Oakman Blvd., Detroit, Mich., announces that at a recent meeting of the board of directors the following officers were elected: N. A. Woodworth, president and treasurer; Phil Huber, vice-president and secretary; J. W. Rothmeyer, vice-president in charge of Krueger-Wayne Division; Thor M. Olson, vice-president in charge of Continental Tool Division; H. R. Krueger, vice-president in charge of engineering; William F. Wise, vice-president in charge of sales; and Glen Bixby and F. F. Murphy, assistant secretaries.

LINK-BELT CO., 910 S. Michigan Ave., Chicago, Ill., has appointed the Stockland Equipment Sales Co., 2628 University Ave., S. E., Minneapolis, Minn., agent in Minnesota and part of Central West Wisconsin for its line of shovels, cranes, and drag lines. The company also announces the appointment of the following distributors for Link-Belt automotive timing chains: Automotive Bearings & Equipment Co., 713-716 Sycamore St., Cincinnati, Ohio; Cartier & Bulman, 2613 Baker Ave., Bell, Calif.; Taft Auto Specialty Co., 305 Center St., Taft, Calif.; Roper Auto Part Co., 2554 Randolph St., Hunting Park, Calif. Joe C. Tucker, Morganfield, Ky., has been appointed agent in his territory for Link-Belt portable loaders.

GOODELL-PRATT CO., Greenfield, Mass., and MILLERS FALLS CO., Millers Falls, Mass., both well-known manufacturers of a broad line of high-grade tools, have been merged. The Millers Falls Co. has been engaged in the manufacture of high-grade tools since 1868, and in 1927 entered the electric tool field. The Goodell-Pratt Co. was started in 1888, manufacturing automatic drills, hand drills, breast drills, drill chucks, and automatic screwdrivers. Precision measuring tools were later added to the line. The Millers Falls Co. will be the operating company, and the officials will be the present officials of the Millers Falls Co., with Philip Rogers, president; George U. Hatch and John W. Smead, vice-presidents; and Earl D. Holtby, treasurer. William M. Pratt, president of the Goodell-Pratt Co., will be a member of the board of directors.

A New Machine *for Fast Production on Short and Long Run Jobs*

the

Brown & Sharpe No. 22 Plain Milling Machine

QUICKER SET-UPS

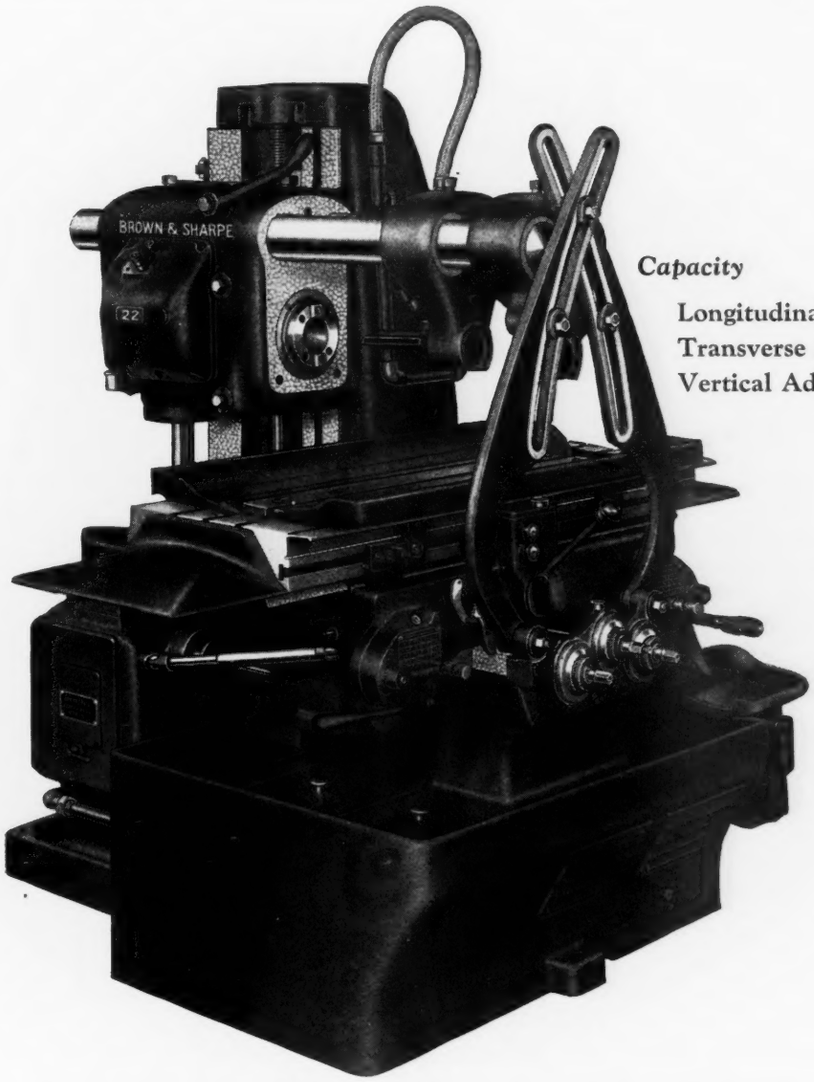
- - - all adjustments and controls at front of machine

REDUCED IDLE TIME BETWEEN CUTS

- - - full automatic operation for table—automatic stop and start for spindle

LOW-COST PRODUCTION

- - - through advanced features of design, construction and control



Capacity

Longitudinal Feed, 22", Automatic
Transverse Adjustment of Saddle, 6"
Vertical Adjustment of Spindle Head, 13"

Set-up time is reduced to a minimum through simplicity, ease of adjustment and convenient location of all controls at the front of the machine. Feed changes and speed changes are each controlled by a single lever.

Dialing operations are facilitated—by simplified clamping and convenient adjustment of the spindle head—by handy transverse adjustment of saddle—by longitudinal adjustment of table—all controlled from front of machine. Large diameter graduated dials assure accurate settings.

Automatic operation of the table, in a variety of cycles, is easily obtained by adjustable dogs on the front of the table. For runs of a few pieces, a single directional engagement lever controls both cutting feed and power fast travel.

The installation of a No. 22 Plain Milling Machine will show reduced costs, particularly on the many short-run jobs that the average shop is not equipped to handle to the best advantage.

Complete specifications sent on request

BROWN & SHARPE

BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.

Coming Events

APRIL 13-17—National Industrial Congress, featuring management, maintenance, and materials handling, to be held in the Public Auditorium, Cleveland, Ohio. For further information, address the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

APRIL 13-18—Second National Industrial Equipment Exposition at the Public Auditorium in Cleveland, Ohio. Managing director, G. E. Pfisterer, 308 W. Washington St., Chicago, Ill.

APRIL 13-18—Eighth annual convention and exhibition of the American Oil Burner Association to be held in Philadelphia, Pa. Harry F. Tapp, executive secretary, 342 Madison Ave., New York City.

APRIL 15-16—Thirty-third annual convention of the National Metal Trades Association at Hotel Sinton, Cincinnati, Ohio. J. E. Nyhan, national secretary, Peoples Gas Building, Chicago, Ill.

APRIL 20-23—Spring meeting of the American Society of Mechanical Engineers at Birmingham, Ala. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

APRIL 27-29—Annual convention of the National Supply & Machinery Distributors' Association, meeting jointly with the Southern Supply & Machinery Dealers' Association and the American Supply & Machinery Manufacturers' Association at the Wardman Park Hotel, Washington, D. C. George A. Fernley, secretary-treasurer, 505 Arch St., Philadelphia, Pa.

MAY 4-9 — Thirteenth Exposition of the Chemical Industries to be held at the Grand Central Palace, New York City.

MAY 4-9—Annual meeting of the American Foundrymen's Association, to be held at the Stevens Hotel, Chicago, Ill. In conjunction with the meeting, a limited exhibition of foundry equipment and supplies will be held. The office of the executive secretary is 222 W. Adams St., Chicago, Ill.

MAY 5-6—Meeting of the Petroleum Division of the American Society of Mechanical Engineers at Hotel Winfield Scott, Elizabeth, N. J. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

MAY 7-8—Production Meeting of the Society of Automotive Engineers and the Milwaukee Section of the Society to be held at the Hotel Schroeder, Milwaukee, Wis. R. S. Burnett, director of production activity, Society of Automotive Engineers, 29 W. 39th St., New York City.

MAY 7-9—Fifteenth annual meeting of the American Gear Manufacturers' Association at the Hotel Statler, Buffalo, N. Y. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland, Ohio.

MAY 27-29—Annual convention of the National Foreign Trade Council to be held at the Hotel Commodore, New York City. O. K. Davis, secretary, 1 Hanover Square, New York City.

JUNE 1-3—Regional meeting of the American Society of Mechanical Engineers at Hartford, Conn. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

JUNE 5-6—Annual convention of the National Association of Foremen at Dayton, Ohio. E. H. Tingley, secretary, U. B. Building, Dayton, Ohio.

JUNE 15-19—Summer meeting of the Society of Automotive Engineers at White Sulphur Springs, W. Va. John A. C. Warner, secretary, 29 W. 39th St., New York City.

JUNE 22-26—Annual meeting of the American Society for Testing Materials at the Stevens Hotel, Chicago, Ill. C. L. Warwick, secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

AUGUST 23-29—International Industrial Relations Congress to be held at Amsterdam, Holland. Further information may be obtained from Mary van Kleeck, Russell Sage Foundation Bldg., New York City.

SEPTEMBER 21-25—Annual meeting of the American Society for Steel Treating and National Metal Exposition to be held at the Commonwealth Pier, Boston, Mass. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

NOVEMBER 30-DECEMBER 5—First National Exposition of Mechanical Handling Equipment to be held at the Grand Central Palace, New York City. Charles F. Roth, Manager, International Exposition Co., Grand Central Palace, New York City.

New Catalogues and Circulars

CHAINS. American Chain Co., Inc., Bridgeport, Conn. Pocket-size booklet containing a complete list of the products of the company.

CRANES. Cleveland Crane & Engineering Co., Wickliffe, Ohio. Circular illustrating and describing Cleveland tramrail gantry cranes.

CRANE CONTROL EQUIPMENT. Electric Controller & Mfg. Co., Cleveland, Ohio. Folder illustrating and describing electric crane control equipment.

MILLING CUTTERS. Brown & Sharpe Mfg. Co., Providence, R. I. Bulletin entitled "It's Economy to Use Cutters that Keep Your Machines at Work."

SHOP HEATERS. Young Radiator Co., Racine, Wis. Booklet H-1230, describing a complete line of unit heaters suitable for buildings, factories, and warehouses.

ELECTRIC FUSES. Ideal Commutator Dresser Co., Sycamore, Ill. Folder illustrating and describing the company's fuse reducers for standard cartridge fuse holders.

SAFETY NUTS. Safety Nut Corporation, Land Title Bldg., Philadelphia, Pa. Circular illustrating and describing the pin-nut type and the brake-lock type of safety nuts.

ELECTRIC TIME SWITCHES. R. W. Cramer & Co., Inc., 67-69 Irving Place, New York City. Bulletin ZWE, illustrating and describing the Sauter electric time switch for off-peak control.

FLEXIBLE COUPLINGS. Lovejoy Tool Works, 319 W. Ohio St., Chicago, Ill. Circular outlining the features of construction of the L-R flexible coupling, containing also list prices and dimensions.

PRECISION INSTRUMENTS. Gaertner Scientific Corporation, 1201 Wrightwood Ave., Chicago, Ill. Catalogue 1, illustrating and describing various types of interferometers and interference apparatus.

TOOL BITS. Vincent Steel Process Co., 2434 Bellevue Ave., Detroit, Mich. Leaflet containing data on Vincent high-speed "Super" tool bits, which are made in five sizes to fit any standard tool-holder.

ELECTRIC WELDING MACHINES. Lenney Machine & Mfg. Co., Warren, Ohio. Bulletin 31, illustrating and describing "Standard" spot welders. Bulletin 32, illustrating and describing "Automatic" spot welders.

POWER PRESSES. Cleveland Punch & Shear Works Co., Cleveland, Ohio. Circular illustrating various types of forging and trimming presses, open-gap punches, multiple punches, bending rolls, and shears.

STEEL FACTORY EQUIPMENT. Standard Pressed Steel Co., Jenkintown, Pa. Circular containing list prices of Hallowell steel workbenches and tables, bench legs, drawers, chairs, stools, tool stands, desks, etc.

FORGING HAMMERS. Nazel Engineering & Machine Works, 4043 N. 5th St., Philadelphia, Pa. Folder entitled "Economical Forging," illustrating and describing the company's motor-driven air-actuated forging hammer.

SHEET-METAL FOLDERS AND BRAKES. Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y. Bulletin 74, illustrating and describing sheet-metal folders and brakes for hand and power operation.

SOUNDPROOF PRODUCTS. Korfund Co., Inc., 235 E. 42nd St., New York City, is publishing a magazine known as *Isolation*, which is devoted to a study of the soundproofing of buildings and the isolation of machine vibration.

ELECTRIC EQUIPMENT. P. E. Chapman Electrical Works, 1820 Chouteau Ave., St. Louis, Mo. Bulletin 115, illustrating and describing the Chapman "Internal Growler" for testing stators and armatures for short circuits without disturbing the connections.

HEAT-TREATING FURNACES. Chicago Flexible Shaft Co., 5600 Roosevelt Road, Chicago, Ill., is distributing to those interested in heat-treating, a publication known as the *Stewart Melting Pot*. This publication contains articles on heat-treating processes and equipment.

NICKEL STEEL. International Nickel Co., Inc., 67 Wall St., New York City. Circular No. 5 in a series on the use and applications of nickel steel. Among the applications shown are automobile parts, oil-well chains, screw machine products, and miscellaneous machine parts.

GAGES. Comtor Co., Waltham, Mass. Bulletin 12, entitled "Precision Made Easy," illustrating and describing the Comtor system of rapid precision gaging and size control in the production and inspection of inside and outside diameters and flat dimensions of mechanical products.

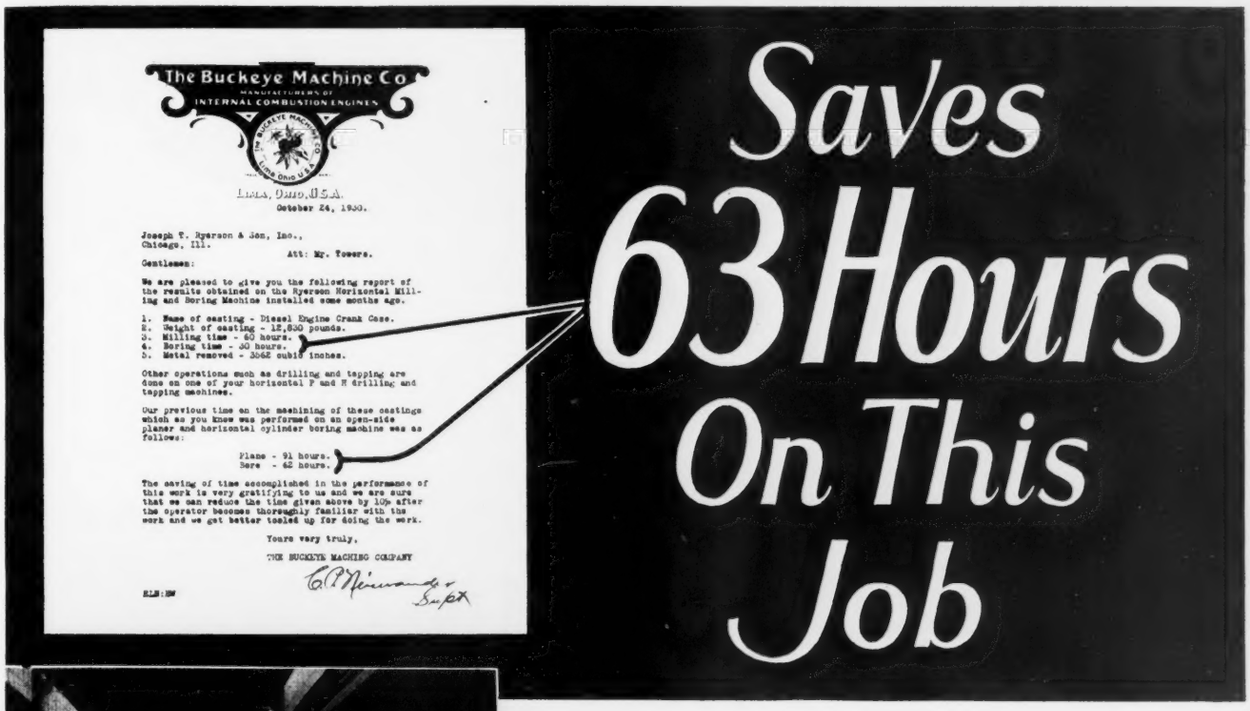
ROLLER CHAIN. Baldwin-Duckworth Chain Corporation, Springfield, Mass. Bulletin 40, covering steel replacement roller chain, designed to run over the same sprockets as the regular sizes of malleable detachable, riveted malleable, or saw mill malleable iron and steel combination chains.

RAILWAY EQUIPMENT. Walter A. Zelnicker Supply Co., St. Louis, Mo. Bulletin 422, listing railway equipment which this company has in stock, including underframe flats, gasoline motor car and trailer, locomotive cranes, switchers, 79-inch wheel lathe, high-pressure tanks, etc.

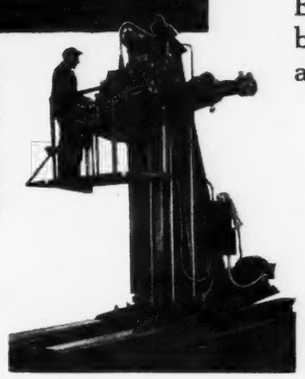
TAP DRILL TABLE. John Bath & Co., Inc., 18 Grafton St., Worcester, Mass. "Tap Drill Selection Table" conveniently mounted on cardboard for use as a wall chart, giving also directions for calculating drill sizes for special taps. The table may be obtained upon application to John Bath & Co., Inc.

ARC WELDING. Lincoln Electric Co., Cleveland, Ohio. Publication entitled "Second Lincoln Arc Welding Prize Competition," giving complete information as to the purpose of the competition, the prizes to be awarded, and the methods of procedure in conducting the contest. A sum of $17,500 will be awarded in forty-one prizes, the first prize being $7500.

OHIO HORIZONTAL BORING, DRILLING AND MILLING MACHINES OHIO


The Buckeye Machine Co
MANUFACTURERS OF
INTERNAL COMBUSTION ENGINES
LIMA, OHIO, U.S.A.
October 24, 1930.
Joseph T. Ryerson & Son, Inc.,
Chicago, Ill.
Att: Mr. Towers.
Gentlemen:
We are pleased to give you the following report of the results obtained on the Ryerson Horizontal Milling and Boring Machine installed some months ago.
1. Name of casting - Diesel Engine Crank Case.
2. Weight of casting - 12,830 pounds.
3. Milling time - 40 hours.
4. Boring time - 30 hours.
5. Metal removed - 3665 cubic inches.
Other operations such as drilling and tapping are done on one of your horizontal P and H drilling and tapping machines.
Our previous time on the machining of these castings which as you know was performed on an open-side planer and horizontal cylinder boring machine was as follows:
Plane - 91 hours.
Bore - 62 hours.
The saving of time accomplished in the performance of this work is very gratifying to us and we are sure that we can reduce the time given above by 10% after the operator becomes thoroughly familiar with the work and we get better tooled up for doing the work.
Yours very truly,
THE BUCKEYE MACHINE COMPANY
Supt.
RLB:BW
Saves 63 Hours On This Job

This large floor type Ohio Horizontal Boring, Drilling and Milling machine is handling the big jobs in the Buckeye Machine Co. plant at Lima, O. Its great vertical and horizontal travel permits work over an exceptionally large area: boring, drilling and milling from the one setting. Complete control is centralized on the operator's platform.



The Buckeye Machine Co. of Lima, Ohio, saved 31 hours' milling time and 32 hours on the boring of this 12,830-pound casting for a Diesel Engine Crank Case. A big saving—typical of what shops can expect from Ohio Horizontal Boring, Drilling and Milling Machines. Ease of operation and convenience of control have been provided, with a sensitiveness rarely found in a machine so powerful.

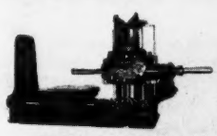
Check up on the possible savings of an Ohio Horizontal Boring, Drilling and Milling Machine in your shop. We will be glad to give you performance data and complete information.

Built in table, planer-table, floor and combination floor and table types.

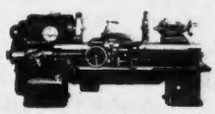
THE OHIO MACHINE TOOL CO., KENTON, OHIO

JOSEPH T. RYERSON & SON, INC.
Chicago and Principal Cities
FINE MACHINE TOOLS
STRUCTURAL—PLATE—SHEET METAL
SHOP EQUIPMENT
RAILROAD MACHINERY
WELDERS—SMALL TOOLS

RYERSON MACHINERY DIVISION of GENERAL DISTRIBUTORS

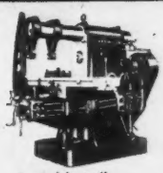


Ohio Horizontal Boring, Drilling and Milling Machines

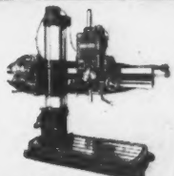


Monotrol and Tritrol Lathes

Ohio Shapers and Planers



Maximillers
Formerly built by Kempsmith



Dresses Radials

SOLD THROUGH EXCLUSIVE LOCAL DEALERS

CLUTCHES. Universal Gear Corporation, 327 S. LaSalle St., Chicago, Ill. Circular descriptive of Pitter one-way clutches, which are so designed that they lock automatically, thus preventing reverse movement. The various features of design are described in detail, and the dimensions of the different sizes are listed. A number of applications of the clutch are shown.

BORING, DRILLING AND MILLING MACHINES. Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Catalogue illustrating and describing the Giddings & Lewis No. 45 high-power precision horizontal boring, drilling, and milling machine and all the recent improvements that have been incorporated in it. Complete specifications of the machine are given.

TRUCKING WHEELS. Metzgar Co., Inc., Grand Rapids, Mich. Catalogue illustrating and describing Metzgar end-wood wheels for trucks. The special features of construction of these wheels are described, and various applications are illustrated. Information is given on the performance of these wheels, lubrication and bearing equipment, and methods of selecting the correct wheel and bearing.

MOTOR DRIVE. Kritzer Co., 515 W. 35th St., Chicago, Ill. Circulars illustrating and describing a floating motor drive which utilizes motor torque to regulate belt tension, and permits the use of short belt centers on all types of belt-driven machinery. A table for selecting the proper motor drive to use for various installations is included, and a diagrammatic application of the drive is shown.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Circulars GEA 193A, 214B, 686, 1262A, 1275, 1352, 1363, and 1368, descriptive of G-E electrically heated glue pots; helicoil sheath-wire immersion heaters; direct-current motors; "Thrustors" for electric motor drives; fractional-horsepower motors; squirrel-cage induction motors; resistor units; and vertical hollow-shaft induction motors for deep-well pumping.

LOCK-NUTS. Aga Co., Elizabeth, N. J. Loose-leaf catalogue containing reproductions of letters from the Department of Commerce and the Navy and Marine Departments, authorizing the use of the "elastic stop-nuts" made by this concern in aircraft construction, as well as letters of recommendation from manufacturers of other products requiring the use of dependable lock-nuts. Tables of dimensions and list prices are included.

SAWS AND TOOLS. Henry Disston & Sons, Inc., Tacony, Philadelphia, Pa., is distributing without charge to users of saws and tools, a publication entitled "Disston Saw, Tool and File Manual." The purpose of the new book is to instruct the tool user in the selection, care, and use of saws, tools, and files. It shows every step necessary for doing accurate work, 229 illustrations being used to make clear the points brought out in the pamphlet.

TUNGSTEN CARBIDE. Firth-Sterling Steel Co., McKeesport, Pa. Booklet on Firthite tungsten carbide, outlining the composition, uses, and advantages of this material for different classes of work. Comparative figures of actual performances of Firthite tungsten-carbide tools in the plants of customers are included. Standard tool list of Firthite tungsten-carbide tools, including tool bits suitable for lathes, automatics, screw machines, boring mills, planers, shapers, etc. Dimensions of shank and tip, as well as prices, are given.

INDICATING AND RECORDING INSTRUMENTS. Brown Instrument Co., 4485 Wayne Ave., Philadelphia, Pa. Catalogue 3004, illustrating and describing the construction and operation of Brown electric carbon-dioxide meters for measuring the amount of carbon dioxide contained in the stack gases of furnaces. The bulletin describes how waste in combustion can be avoided by the use of these instruments. Circular illustrating the Brown electric flow meter, which records the amount of steam, water, gas, etc., used in a plant, and the exact time when it was consumed.

PUMPS. Geo. D. Roper Corporation, Rockford, Ill. Catalogue entitled "The Heart of Power," descriptive of the hydraulic power transmission equipment made by this concern. Various types of pressure pumps are shown, and charts of capacity and horsepower performance curves for these pumps are included. The last section of the catalogue, entitled "Useful Facts About Hydraulic Power Transmission," contains tables of capacity and horsepower, approximate weights of petroleum oil, theoretical discharge of nozzles, oil specifications, capacities of hydraulic rams, and a chart for determining the rate of flow required for given ram sizes and speeds.

BALANCING MACHINES. Tinius Olsen Testing Machine Co., 500 N. 12th St., Philadelphia, Pa. Catalogue 50, Part K, on balancing equipment. This is an unusually complete catalogue of balancing machines for practically every industrial purpose. In addition, the catalogue, which is virtually a text-book on balancing, contains an exceptionally clear and concise treatise on static and dynamic balancing, with practical applications to the balancing of different machine parts and assembled mechanisms. Detailed directions are also given for the use of each machine and instrument illustrated and described. The balancing of automobile propeller shafts, crankshafts, long cylinders and tubes, fans and blowers, motor and generator armatures, steam turbines, aircraft propellers, and complete assemblies are referred to in special sections.

New Books and Publications

HOUSE WIRING. By Thomas W. Poppe and Harold P. Strand. 224 pages, 4 1/4 by 6 1/2 inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $1.

THE COLUMN ANALOGY. By Hardy Cross. 78 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 215 of the Engineering Experiment Station. Price, 40 cents.

FULL-DISK BUFFING WHEELS. 12 pages, 6 by 9 inches. Published by the United States Department of Commerce, Washington, D. C., as Simplified Practice Recommendation No. R115-30 of the Bureau of Standards.

SAFETY ACTIVITIES IN SMALL COMPANIES. 16 pages, 5 1/4 by 7 1/2 inches. Published by the Metropolitan Life Insurance Co., 1 Madison Ave., New York City, as Industrial Safety Pamphlet No. 10 of the Policyholders' Service Bureau.

ABSTRACTS OF SCIENTIFIC AND TECHNICAL PUBLICATIONS FROM THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY. 56 pages, 6 by 9 inches. Published by the Massachusetts Institute of Technology, Cambridge, Mass.

PACKAGING OF CARRIAGE, MACHINE, AND LAG BOLTS. 18 pages, 6 by 9 inches. Published by the U. S. Department of Commerce, Washington, D. C., as "Simplified Practice Recommendation" No. R60-30 of the Bureau of Standards.

TESTS OF A MIKADO TYPE LOCOMOTIVE EQUIPPED WITH NICHOLSON THERMIC SYPHONS. By Edward C. Schmidt, Everett G. Young and Herman J. Schrader. 102 pages 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 220 of the Engineering Experiment Station. Price, 55 cents.

TREATISE ON LEATHER BELTING. By George B. Haven and George W. Swett. 249 pages, 5½ by 8 inches; 77 illustrations; 25 tables. Published by the American Leather Belting Association, New York City. Price, $1.50.

The leather belting industry has published an unusually complete and authoritative book on leather belting. The authors are professors of machine design at the Massachusetts Institute of Technology, but have obtained their information, to a large extent, from data in the hands of leather belting manufacturers and belting users. They have also examined the records of tests made in engineering schools, such as the Mellon Institute, Cornell University, Ohio University, and other laboratories. The book is one that should be of great service to draftsmen and designers, plant and production engineers, and shop superintendents. It should also be of great value to construction engineers, millwrights, central power-station engineers, and plant architects. Both machinery manufacturers and machinery users will find in this book a wealth of reliable engineering data. The book is divided into ten chapters headed as follows: Leather Manufacture; Physical Properties of Belting Leather; Methods of Manufacture of Leather Belting; Belting Practice; Installation and Care of Leather Belting; Leather Belts on Motor Installations; Belt Drive Engineering; Belt Research; Specification and Inspection; and Tables, Nomographs, and Plots.

MODERN DIESEL ENGINE PRACTICE. By Orville Adams. 656 pages, 6 by 9 inches, 369 illustrations. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $6.

For several years the author of this work has supplemented his consulting engineering practice by gathering notes and data for a book on Diesel engine application and practice that would combine a reference book on construction and design with a practical operator's manual. The material presented in this book is the result of the collection of these notes, in addition to a great deal of research supplemented with considerable personal experience. As the Diesel engine is destined to become of great importance in the solution of the problem of the power supply of the future, the book is timely and should prove a valuable work of study and reference to engineers directly or indirectly interested in the power field.

The best conception of the wide scope of this work may be obtained from a list of the chapter headings: Evolution and History; Introduction and General Considerations; Technical Application of Diesel Engines; Stationary Applications of Diesel Power; Portable and Mobile Diesel Applications; Operation of Diesels; Operating the Bessemer Four-stroke Cycle Solid Injection Engine; Operation of the Air Injection McIntosh & Seymour Diesel Engines; Diesel Operating Experience; Diesel Engine Maintenance Practice; Engineering the Diesel Plant; Efficient Lubrication; Piston-ring Relation to Efficient Lubrication and Economy of Operation; Diesel Repair and Maintenance; Packard-Diesel Aircraft Engines; Diesel Locomotive Engine Construction and Repair; Diesel Locomotive Engine Fuel Injection Timing and Control; Automotive Applications of Diesel Engines.

In the preparation of the book, practically all the companies manufacturing Diesel engines in the United States have cooperated with the author.

The value of a Going Concern depends upon where it's going!

As a result of letting their shop equipment become obsolete, some concerns are rapidly *going to seed.* Others are *going ahead,* keeping their machine tool equipment up-to-date, and consequently are *getting somewhere.*

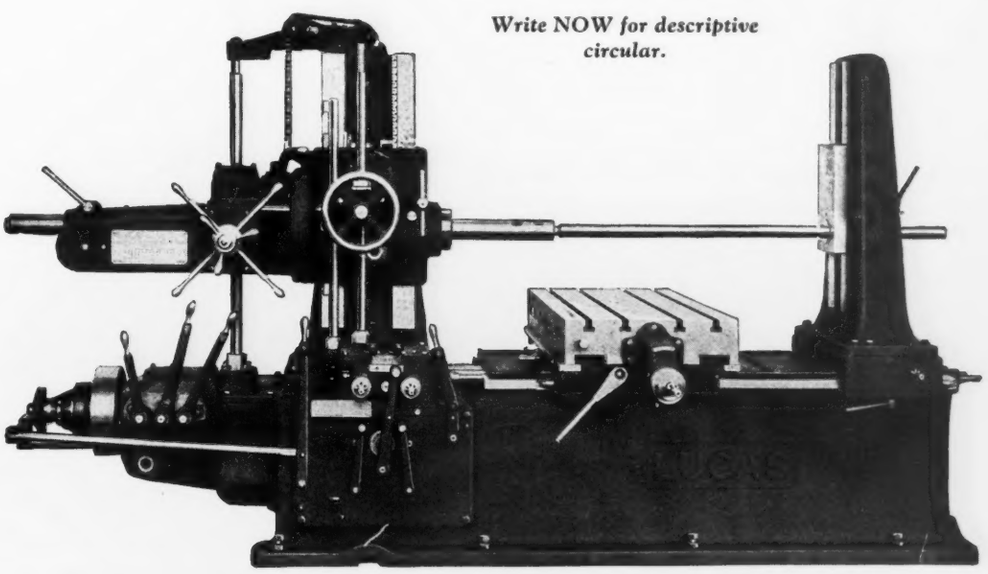
Which Policy are You Following? Where are You Headed?

Production can be increased by installing this faster, more powerful, and convenient machine. Costs will be still further reduced by the elimination of subsequent fitting and selecting of parts in assembling, due to the exactness with which they have been bored and milled—a direct result of the increased rigidity, maintaining accuracy of alignment, that is built into the

Latest Type LUCAS

"Precision" Horizontal Boring, Drilling and Milling Machine

Write NOW for descriptive circular.



Upon request, we will send one of our representatives to go over your work and explain our machine in full detail. There will be absolutely no obligation to you. When may he call?

THE LUCAS MACHINE TOOL COMPANY, Cleveland, O.

FOREIGN AGENTS: Allied Machinery Co., Barcelona, Zurich. Andrews & George Co., Tokyo. Catmur Machine Tool Corp., Ltd., London, Eng. M. Kocian & G. Nedela, Prague. V. Lowener, Copenhagen, Oslo, Stockholm. Emanuele Mascherpa, Milan, Italy. R. S. Stokvis & Zonen, Rotterdam, Paris.

Classified Contents of this Number

Automobile Shop Practice

Cutting Compounds Used by Ford—*By Charles O. Herb* ... 569
Tungsten Carbide in an Automobile Plant ... 573

Design, Fixture and Tool

Designing an Unusual Milling Fixture—*By Walter H. Friedrich* ... 577
Single-dial Indexing Head for High Number of Divisions—*By F. H. Beulwitz* ... 582
Drill and Counterbore for Soft Rubber—*By H. C. Meyers* ... 603
Adjustable Boring, Facing and Turning Tool—*By W. N. Delenk* ... 606
Indexing Indicator for Spacing Keyways—*By Joseph C. Coyle* ... 607
Toggle Fixture for Spinning the Ends of Tubes—*By Thomas F. Morrissey* ... 608
Simple Offset Boring Head—*By Frank X. Sommers* 613
Arbor for Turning Clearance on Cutters—*By Joseph Abbazia* ... 613
Drum Type Fixtures Increase Milling Machine Output ... 616

Design, Machine

Reversing Mechanism which Varies Point of Reversal—*By Olaf Anderson* ... 587
Planetary Type of Crank Motion for Obtaining Dwell—*By C. H. Van Fossen* ... 588
A Clearing House for Machine Design Data ... 589
Know Your Handbook—*By Edward Heller* ... 591
New Cam Grinding Device of British Design ... 592
Flexible Shafts and Their Application—*By James M. Talbot* ... 594
Design of Static Balancing Machine—*By George L. Pyritz* ... 602
Design of Machine for Bending Copper Pipe—*By Paul H. White* ... 618
Sharp Corners in Castings ... 623

Diemaking and Die Design

Electrical Tripping Device for Indexing Die—*By E. Martinet and A. Collier* ... 574
Swaging Die for Assembling Collar on Shaft—*By F. C. Mason* ... 605
Die for Correcting Error in Gears—*By I. C. Gellman* ... 607
Metal-working in Power Presses ... 611
Arbor for Grinding Slotted Die Inserts—*By W. C. Betz* ... 612
Dies for Blanking Mica ... 614
Die for Drawing Deep Shells—*By Edward Heller* 615
Self-contained Spring Unit for Stripper Plate ... 628

Education, Trade and Engineering

How Many Apprentices Finish Their Course?—*By C. J. Freund* ... 576
How Much Education Should the Employer Pay For?—*By E. L. Fairall* ... 590
Training Teachers for Trade Schools—*By J. E. Fenno* ... 591
Milwaukee Apprentice Awards ... 611
The Coordinator in Cooperative Trade Education—*By Traver C. Sutton* ... 621

Inspection and Gaging Methods

Inspection Gage with Micrometer Head—*By W. E. Gunnerson* ... 604
Adjustable Gage for Setting Milling Cutter—*By D. A. Baker* ... 609
Magnetic Methods of Testing Welds ... 624

Management Problems

White Elephants in the Shop ... 586
Low Production Cost not a Sure Sign of Profits ... 586
Why the Jobbing Shop is Unprofitable—*By J. H. Sternbergh* ... 590
Are Orders Always Orders?—*By Raymond H. Dauterich* ... 590
Taking Charge of a Department—*By Charles H. Willey* ... 590
How can a Foreman Best Instruct His Men?—*By John A. Honegger* ... 591
Most Economical Number of Parts per Run ... 614
Machinery Approved by Firm's Representative—*By Leo T. Parker* ... 615
A Rating Card for Toolmakers and Machinists—*By William C. Betz* ... 622
Alvan T. Simonds on the Business Prospects ... 627

Materials, Metals and Alloys

Special Alloys for Automobile Engines ... 589
Keeping Die-castings Free from Impurities ... 600
A New Semi-stainless Steel ... 601
Aluminum Flanges for Ammonia Pipe Joints—*By C. J. Drolz* ... 612
Present-day Nickel-plating Practice ... 620
Hard-facing and its Practical Applications ... 627

Railway Shop Practice

Lever Feed for Air Drill Used in Locomotive Shop—*By E. A. Lotz* ... 599
Portable Kerosene Cleaning Vat—*By W. L. Parrish* 599

Safety Methods

Competitions for "No-accident" Records—*By Harry Kaufman* ... 591
Safety Precautions in Gas Cutting ... 609
Punch Press Guard Adjustable to Die Size ... 623

Shop Practice, General

Speeds and Feeds for Drilling ... 584
A Large European Planer ... 601
Use of Indexing Head for Hobbing Work-gears—*By Kurt F. Ziehm* ... 606
Pressing Bakelite Disks at High Speed ... 610
Lapping with Pumice Paste—*By W. E. Warner* ... 612
Board Designed to Keep Tools in Place—*By Charles Klyne* ... 612
Preventing Lead from Adhering to Steel Parts—*By R. A. Dressler* ... 613
Development of Automatic Internal Grinding ... 617
Machining Sixty Spiders per Hour on Four-way Drill ... 628
New Shop Equipment ... 629

Unemployment

Two Thousand Employes Aided ... 603
Avoiding Unemployment in Future Depressions ... 616
Rochester Unemployment Insurance Plan ... 622

Welding Practice

Arc Welding of Pressure Vessels ... 585
Manganese Steel Welding Rod ... 593
Present Practice in Making and Testing Welds ... 626

Articles Coming in May Machinery

Sixty-foot Locomotive Beds Made in One Piece—How Glue Affects the Costs of Polishing—Moving a Large Machine Shop—Grinding the Six Sides of Nuts in One Operation—Milling Around Obstructions—Unusual Crowning Fixture

Your Progress Depends Upon Your Knowledge of Your Industry